ingegneria sismica
International Journal of Earthquake Engineering
Anno XLIII - Num. 2 - 2026

Transmedia Communication Strategies for Puppet Animation Narratives within a Digital Humanities Framework

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SUMMARY: *Puppet animation has multiple attributes such as video narrative, physical material, puppetry technology and cultural memory, and its cross-media communication cannot only rely on the distribution of the original movie, short video clips or social platform forwarding. Aiming at the problems of dispersed narrative units, difficult transformation of craft information, insufficient explanation of cultural motifs, and difficult return of feedback from platforms in existing communication practices, this paper builds a sample library of puppet animation narratives under the framework of digital humanities, and organizes the text of the work, the platform dissemination materials, the production process, the cultural motifs, and the public commentaries into a heterogeneous map of the narrative media. The study sets the indicators of narrative retention, media coupling, interaction intensity, cross-media transformation rate and interpretation quality, and codes and models 68 puppet animation works, 3286 platform communication materials and 42615 public comments. The results show that the cultural knowledge visualization strategy has the highest composite score of 0.724; the interaction intensity of the material and craft subtexts reaches 15.6 per 1,000 exposures; and the cross-media conversion rate of audience participatory co-creation reaches 12.3%. The ablation results showed that the composite score decreased by 12.8% after removing the material-craft label, therefore this shows that the explanation on material attribute of puppet animation is one key variable in cross-media communication. This research further puts forward strategies for the work assignment among the primary film, short video, social media, digital archive, exhibition place, and VR/AR experience, providing a reusable methodological path for the digital dissemination of puppet animation, the display of non-heritage, and the operation of cultural content.*

KEYWORDS: *digital Humanities; puppet Animation; cross-media communication; narrative media heterogeneity map; cultural heritage; stop-motion animation*

1 Introduction

Puppet animation does not face a single screening problem in the contemporary communication environment. When a work enters the online platform, feature films, character posters, production footage, props displays, creator interviews, museum archive pages, and offline exhibition materials coexist. The audience's interest in puppet animation also comes not only from the plot itself, but also from the physical texture of the puppets, the traces of puppet manipulation, the frame-by-frame filming process, and the craftsmanship and cultural origins behind the characters. Puppets, as performance objects, are both character vehicles and cultural objects that can be viewed, disassembled and interpreted, and Maselli's study of puppet

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https://doi.org/10.65102/is2026763
Published: 30 April, 2026

multimedia archives suggests that narratives of puppetry need to cover aesthetic value, symbolic value, material characteristics and production processes simultaneously [1]. This makes the communication of puppet animation a natural cross-media condition: the video advances the story, the archive interprets the object, the exhibition presents the physical object, and the interactive medium transforms the puppet experience.

The specificity of stop-motion puppet animation comes firstly from the materials and movement mechanisms.Maselli's overview of the evolution of stop-motion animation techniques shows that the history of puppet animation has long been associated with experiments with materials, manufacturing processes, replacement part technology and updates in filming equipment [2].Wells regards animated objects as "scripted objects" that can participate in narrative organization [3]. Wells views animated objects as "scripted objects" capable of participating in the organization of a narrative, emphasizing that object form, materiality, and movement change the viewer's understanding of the character [3]. On a more specific material level, fabric skins, clay traces, wooden joints, and metal skeletons are not simply production materials; the analysis which Maselli did on cloth puppets gives forward the idea that cloth surface can produce metanarratives which talk about nostalgia [4], vulnerability and memory, and the research which Eivazy and other persons did This s research on people-together participation in stop-motion animation further proves the capability that object touching and frame-by-frame controlling can arouse group memories and build a belonging feeling in the creation procedure. procedure to build up a feeling of belonging [5]. These studies suggest that the communicative value of puppet animation needs to be expanded from "how the story is viewed" to "how the material is understood".

Cross-media narrative research provides a theoretical basis for the distribution of puppet animation, and Jenkins understands cross-media narrative as the distributed unfolding of story elements across multiple mediums, each of which should provide a relatively independent contribution to the story world [6]. Scolari points out that cross-media structures create different types of implied consumers and story world entrances, both from the semiotics and narratology perspectives [7]. Adams and Barbour's study of real-time social paratexts suggests that social platform material is less narratively coherent if it is removed from the core text and the context in which it is posted [8].Sánchez-López et al.'s study of digital narrative creators suggests that interactivity, hypermedia, and transmediality have become important features of new narrative forms [9]. These judgments apply to puppet animation, but they still need to be reinterpreted in relation to the materiality of puppet animation. Short video clips, physical exhibits and digital archives of puppet animation are not collateral publicity materials of the main film, they can take on the functions of narrative extension, craft illustration and cultural interpretation.

Cultural heritage digital communication research provides application scenarios for this issue.Psomadaki et al. in their study of urban cultural heritage digital narratives point out that digital narratives can promote audience participation through non-linear interaction and content contribution mechanisms [10]. Way and Wei's Construction of a VR Puppet Show system in the cloud demonstrates that virtual reality is able to transform traditional puppet performances into a telecollaborative and immersive experience [11]. Kasemsmsaki and Wei's construction of a VR puppet theater system in the cloud demonstrates that virtual reality is able to convert traditional puppet performances into telecollaborative and immersive experiences [11]. Kasemsarn and Nickpour's review of digital narratives for cultural tourism further suggests that social media platform integration, multimedia engagement, community participation, and cultural authenticity are important framing elements for young users [12]. Puppet animation is highly relevant to these scenarios: it can be disseminated as online audiovisual content as well as accessed in museums, non-heritage education, cultural tourism spaces and interactive

exhibitions. The problem is that existing practices often consider different media as distribution channels, and lack methods to organize canonical films, crafts, archives, social interactions and exhibition experiences into a unified narrative system.

Digital humanities approaches are capable of dealing with this class of multi-sourced, heterogeneous, and interpretable cultural objects. Knowledge mapping research emphasizes the organization of complex materials through entities, relationships, and semantic constraints [13]; Liem et al. propose a visual narrative workflow for cultural heritage that accesses cultural object retrieval, curation, visual analysis, and storytelling in the same process [14]; and Mayr et al.'s study on an integrated visualization platform for tangible and intangible cultural assets illustrates that cultural objects, historical figures, and multimodal media can be be linked through digital humanities knowledge mapping [15]. At the level of narrative presentation, Segel and Heer's research on narrative visualization shows that data graphics can take on explanatory and guiding functions [16]; Panagiotidou et al.'s study on uncertainty in digital humanities visualization reminds that cultural data often have source differences, semantic ambiguities, and interpretive boundaries, and that uncertainty accounts need to be retained in visualization and evaluation [17]. Therefore, the key to cross-media dissemination of puppet animation is not just expanding platform coverage, but transforming narrative elements, media vehicles, craft materials, and audience feedback into relational networks that can be analyzed, interpreted, and deployed.

Three types of deficiencies still exist in existing puppet animation communication practices. First, there is a lack of stable mapping between the narrative main axis and the subtext. Positives are responsible for character relationships and conflict advancement, short videos are responsible for production spectacle, social media are responsible for topic proliferation, and archive pages are responsible for material preservation, but these materials often do not share the same set of narrative units. Second, material and craft information is often treated as behind-the-scenes content, failing to translate into evidence of character understanding, emotional identification, and cultural interpretation. Third, platform feedback lacks a return mechanism. Comments, retweets, favorites, and secondary creations can reflect viewers' concerns about characters, craftsmanship, and cultural matrices, but these data are seldom reused for communication strategy adjustment. The above deficiencies make the cross-media dissemination of puppet animation easy to be manifested as a multi-platform pile-up rather than an orderly expansion of the story world.

Cross-media dissemination of puppet animation needs to deal with three sets of relationships at the same time: the relationship between image narratives and physical materials, the relationship between platform dissemination and cultural interpretation, and the relationship between audience feedback and subsequent content organization. In the absence of a unified data structure, positive films, short videos, archive pages, exhibition materials and interactive experiences are easily split into unrelated communication segments; if the materiality of puppets is ignored, replacement of faces, joint motions, fabric textures and frame-by-frame traces are difficult to be transformed into resources for narrative understanding. Focusing on this issue, this paper incorporates the texts of puppet animation works, platform communication materials, production processes, cultural matrices and public comments into the same digital humanities analytical framework, constructs a narrative media isomorphism map, and compares the differences between different communication strategies in terms of narrative retention, interaction intensity, cross-media transformation and interpretive quality.

The work in this paper focuses on three aspects. First, to establish a library of narrative samples for cross-media communication of puppet animation, and to unify characters, events, spaces, materials, cultural matrices and audience feedback as codable objects. Second, the heterogeneous relationship between narrative nodes, media nodes and feedback nodes is

constructed, and the transformation effect of communication materials is portrayed in terms of media coupling degree, narrative retention degree and interaction intensity. Third, combining strategy grouping, module dissolution and case window analysis, we propose a content division of labor among the main film, short video, social media, digital archive, exhibition space and VR/AR experience to provide a reusable path for the digital communication and cultural interpretation of puppet animation.

2 Methods

2.1 Construction of the Sample Repository and Narrative Coding

This present paper has constructed a digital humanities sample storehouse of publicly open puppet animation works and their cross-media spreading materials. The sample time scope is 2014-2025, and the selection standards have three items: the work utilizes entity puppets, substitute components, clay figures, cloth dolls, or other operable solid objects as the main performance carrier; this work possesses traceable communication materials in no less than two media scenarios; and the propaganda materials can be connected with clear characters, story lines, making procedures, culture origins, or audiences' feedback. The final sample we obtained is composed of 68 works, 436 feature or clip materials, 3,286 platform communication materials, 512 craft and cultural descriptions, and 42,615 public comments from the masses. The kinds of platforms contain long-length video platforms, short-length video platforms, social media platforms, digital storehouses or museum web pages, off-line exhibition records, and VR/AR experience records. The comment data only keeps gathered topics, emotional inclinations, and interaction actions, and does not record user identification information. Table 1 provides the data origins, scopes and processing standards of the sample storehouse.

Table 1: Data Sources and Processing Fields for the Cross-Media Puppet Animation Sample Repository

Data Category	Source Measure	Sample Size	Main Fields	Processing Method
Artwork Metadata	Production company pages, screening records, platform entries	68 works	Year, duration, production method, genre, distribution path	Deduplication, unified work numbering
Full Films and Clips	Long video platforms, film festival pages, official clip releases	436 entries	Characters, events, scenes, shot segments	Segmented narrative unit annotation
Platform Dissemination Materials	Short videos, social media, archival pages, exhibition records	3286 entries	Platform, time, media format, narrative direction	Establish media carrier tags
Public Comments	Public text sampling from comment sections	42615 entries	Emotional tendency, themes of interest, interaction behavior	Anonymization, aggregate statistics
Craft and Cultural Materials	Interviews, production notes, exhibition descriptions	512 entries	Materials, craft, cultural motifs, creative explanations	Link characters with event nodes

In Table 1, work metadata is used to identify work boundaries, positives and clips are used to extract narrative spindles, platform dissemination materials are used to identify media carriage, public comments are used to calculate feedback themes, and craft and culture materials are used to complement puppet-making and cultural matriarchal explanations. To minimize bias due to platform differences, the communication materials counted interaction data in a 14-day window; data beyond the window were only used for long-term trend checking and did not enter the main results calculation.

Narrative coding uses six types of master tags: character, event, space, material, cultural matrices, and audience feedback. Character tags record protagonist, supporting, and group roles and their relationships; event tags record conflict, twist, repair, and ending nodes; space tags record domestic, staged, nature, fantasy, and historical scenes; material tags record fabric, wood, clay, metal skeleton, replacement faces, handmade traces, and wear and tear textures; cultural matriarchal tags record folktales, local rituals, festival symbols, craft genealogy, and non-heritage The audience feedback tags recorded comment themes, emotional polarity, retweet intent, and secondary creation cues. Three coders cross-coded 18% of the samples, and Cohen's kappa was 0.84, indicating an acceptable level of label consistency. The sample library unifies work texts, media materials, process descriptions, and audience feedback into computable narrative units, and the data organization mechanism is shown in Figure 1.

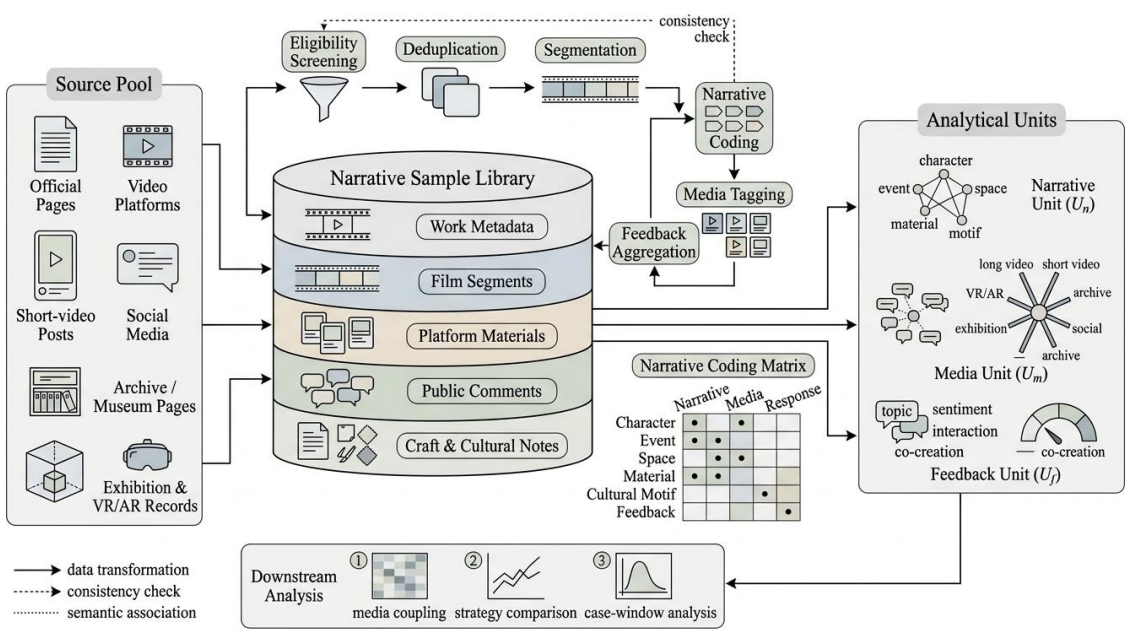

Figure 1: Data organization mechanism for the puppet animation narrative sample repository.

Figure 1: Data organization mechanism for the puppet animation narrative sample repository.

This coding method draws on the approach used in visual data narrative research regarding the relationships among "materials, story fragments, and shared stories" [18], and also references the distinctions made in data storytelling research regarding narrative structure, media presentation, and user reading paths [19, 20]. Unlike typical animation dissemination samples, this study treats puppet materials and craftsmanship as separate primary tags, as this information directly influences character texture, audience emotional judgment, and cultural interpretation capabilities. A single dissemination item may contain multiple tags; for example, a short video of a face swap might fall under the "Materials" tag while also being associated

with "Character Expressions" and "Production Process"; a museum archive page might fall under "Cultural Motifs" while also being associated with "Scene Props" and "Craft Genealogy."

2.2 Narrative Media Heterogeneous Graph and Definition of Indicators

After we finish the coding work of the sample database, this paper then goes to build a narrative media heterogeneous graph. The heterogeneous graph is utilized by people to depict the connections that exist among narrative units, media carrying bodies, and audience feedback. The nodes can be divided into three kinds: narrative nodes, media nodes and feedback nodes. Narrative unit points include roles, happenings, places, substances, and cultural symbols; media nodes include long-length videos, short-length videos, social media, digital storage libraries, display shows, and VR/AR experiences; feedback nodes have contained comment subjects, emotion tendencies, store behaviors, share actions, derived creations, and cross-medium direction guiding. Side lines express narrative connections, media spreading, and feedback starting points. The process of community discovery and network visualization utilizes the Louvain method and the Gephi network exploration methods, just like what is shown in Equation (1).

$$G = (V, E, W), \quad V = V_n \cup V_m \cup V_f, \quad E = E_{nn} \cup E_{nm} \cup E_{mf} \tag{1}$$

In the formula, G denotes the narrative-media heterogeneous graph; V denotes the set of nodes; E denotes the set of edges; W denotes the set of edge weights; V_n denotes narrative nodes; V_m denotes media nodes; V_f, denotes feedback nodes; E_{nn} denotes the relationships between narrative nodes; E_{nm} denotes the carrier relationships between narrative nodes and media nodes; E_{mf} denotes the trigger relationships between media nodes and feedback nodes. Edge weights are determined jointly by co-occurrence frequency, citation relationships, temporal proximity, and interaction intensity. Narrative retention is used to measure whether a given dissemination material retains core narrative information. Communication materials related to puppet animation are often broken down into short video clips, illustrated descriptions, or exhibition texts. If only interaction volume is counted, it is impossible to determine whether the communication still points to the central theme of the work. Therefore, this paper incorporates character relationships, key events, material clues, and cultural motifs into the weighted calculation, as shown in Equation (2).

$$R_i = \frac{\sum_{j=1}^{q_i} \omega_j \, x_{ij}}{\sum_{j=1}^{q_i} \omega_j}, \quad x_{ij} \in [0,1] \tag{2}$$

In the formula, R_i represents the narrative retention rate of the ith piece of promotional material; q_i denotes the number of narrative elements covered by that material; ω_j represents the weight of the jth narrative element; and x_{ij} represents the retention value of the ith narrative element in the jth piece of material. Character arcs, key events, and cultural motifs are assigned higher weights than ordinary scenes, event announcements, and purely informational content.

Media conjunction means the level of compatibility that exists between narrative components and media platforms. If one narrative element shows up many times in a certain kind of media and produces a high gathering of comments together with cross-media direction finding, this shows a high level of connection between this element and the medium, as what is displayed in Equation (3).

$$C_{ab} = \lambda_1 F_{ab} + \lambda_2 R_{ab} + \lambda_3 A_{ab} + \lambda_4 T_{ab}, \quad \sum_{k=1}^{4} \lambda_k = 1 \tag{3}$$

In the equation, C_{ab} represents the coupling degree between narrative elements of category a and media carriers of category b; F_{ab} represents the normalized frequency of occurrence; R_{ab} represents the average narrative retention; A_{ab} represents the concentration of commentary themes; and T_{ab} represents the contribution to cross-media transitions. In this paper, we set λ_1=0.25, λ_2=0.35, λ_3=0.20, and λ_4=0.20 to ensure that narrative retention is given a higher weight in the coupling calculation.

Interaction intensity is utilized by researchers for carrying out comparison of audience responses to propaganda content on various different platforms. Because the platform reach has obvious differences, this thesis therefore does not make direct comparison on the total quantities of likes, comments, shares, and saves; on the contrary, it carries out standardization for these metrics on a per-thousand-impressions foundation, just like what is shown in Equation (4).

$$E_i = \frac{L_i + C_i + S_i + P_i}{N_i} \times 1000 \tag{4}$$

In the formula, E_i represents the interaction intensity of the ith piece of content; L_i represents the number of likes; C_i represents the number of comments; S_i represents the number of shares; P_i represents the number of saves or repeat visits; and N_i represents the number of impressions. For platforms where impression data is unavailable, the median impression count for the same platform and period is used as an estimate, and this is noted separately in the error analysis. The composite score is used to evaluate the overall performance of the dissemination strategy. A puppet animation dissemination strategy must maintain narrative coherence while generating platform engagement and cross-media conversion, and simultaneously explain the materials, craftsmanship, and cultural motifs. This paper incorporates narrative retention, interaction intensity, conversion rate, and explanatory quality into a single evaluation formula, as shown in Equation (5).

$$M_s = \alpha \overline{R}_s + \beta \overline{E}'_s + \gamma \overline{T}_s + \delta \overline{Q}_s, \quad \alpha + \beta + \gamma + \delta = 1 \tag{5}$$

In the formula, M_s represents the composite score for Category s dissemination strategies; $\overline{R}_s$ represents the average narrative retention rate; $\overline{E}'_s$ represents the normalized interaction intensity; $\overline{T}_s$ represents the average cross-media conversion rate; $\overline{Q}_s$ represents the average explanatory quality; α, β, γ, δ and represent the weights of the four indicators. In this study, α is set to 0.30, β to 0.25, γ to 0.25, and δ to 0.20, ensuring that narrative retention and dissemination conversion are both included in the evaluation. A heterogeneous graph organizes narrative units, media carriers, and feedback themes into a computable network; the relationships among variables are shown in Figure 2.

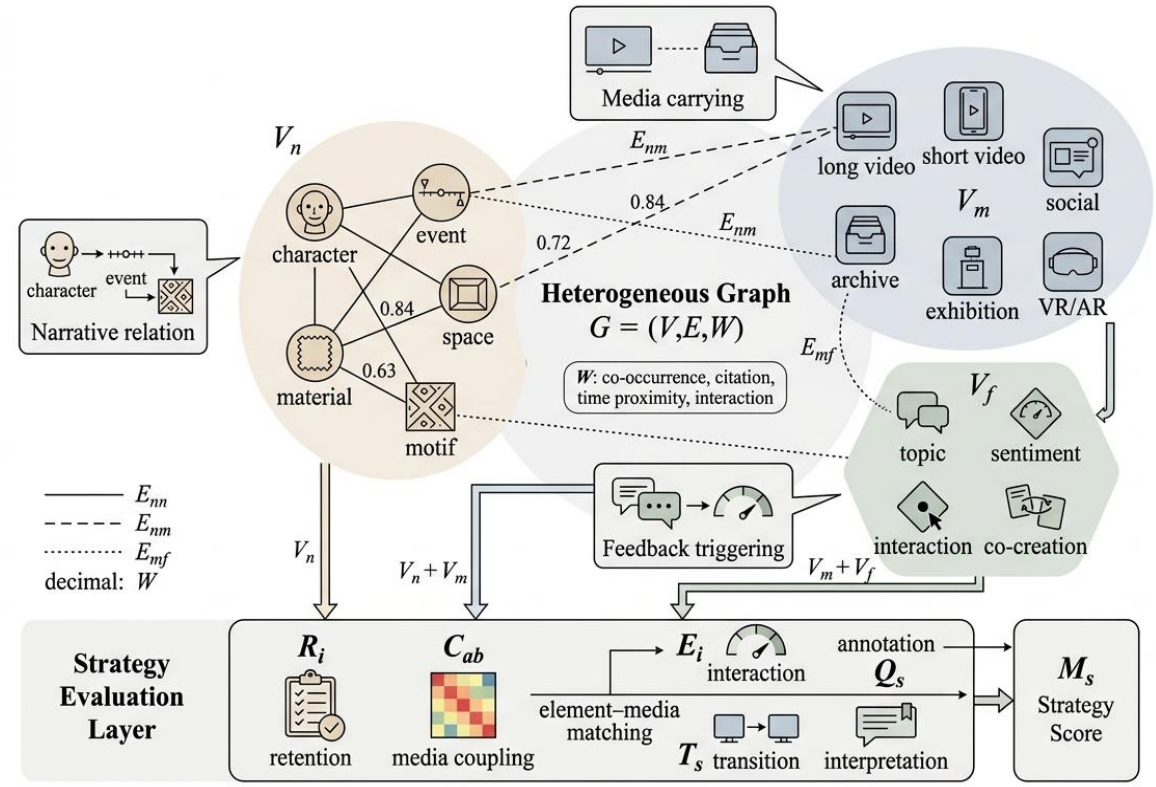

Figure 2: Relationship between the narrative media heterogeneity map and evaluation variables.

2.3 Strategy Groups, Experimental Protocols, and Validation Methods

The experiment classified effective communication materials into six types of strategy groups. s0 is single-platform baseline release, which mainly refers to the main film or clip being disseminated on a single platform; s1 is parallel portage, which means that the same content is released synchronously on multiple platforms; s2 is character cue extension, which forms multi-platform content around character relationship, character tone, character movement and character motivation; s3 is material and craft paratext, which transforms puppet making, replacement of face, S3 is material and craft subtext, which transforms puppet making, face replacement, fabric texture, joint movement and frame-by-frame filming into communication materials; S4 is cultural knowledge visualization, which transforms folk stories, non-heritage techniques, prop sources and local symbols into illustrations, archive pages or interactive pages; and S5 is audience participatory co-creation, which creates a flow of communication back to the audience through commenting on the continuation of the story, voting for the characters, second creation tasks and offline puppet manipulation experience. For the delineation of social media functional blocks and platform affordance, we refer to Kietzmann et al. and Treem and Leonardi's discussion of platform visibility, persistence, editability, and relevance [23, 24]; and for the definition of the basis of user-generated content and interactive communication, we refer to Kaplan and Haenlein's explanation of social media [25]. The communication strategies are grouped with adapted media, as shown in Table 2.

Table 2: Grouping of Dissemination Strategies and Matching Media

Strategy Group	Strategy Meaning	Effective Sample Size	Main Adaptation Media	Core Evaluation Indicators
S0	Single Platform Baseline Release	318	Long Videos, Short Videos	$R_i,\ E_i$
S1	Parallel Carryover	402	Long Videos, Short Videos, Social Media	$E_i,\ T_s$
S2	Character Clue Extension	486	Social Media, Short Videos	$R_i,\ T_s$
S3	Material and Craft Subtext	551	Short Videos, Social Media, Exhibitions	$R_i,\ E_i,\ Q_s$
S4	Cultural Knowledge Visualization	416	Digital Archives, Museum Pages, Graphic Platforms	$R_i,\ T_s,\ Q_s$
S5	Audience Participatory Co-Creation	331	Social Media, Offline Activities, VR/AR	$E_i,\ T_s$

Evaluations are aggregated at the work level, using the communication material as the basic unit. Each piece of material counts the intensity of interaction, cross-media conversion rate, completion rate, and quality of interpretation within 14 days of publication. Cross-media conversion rates were based on skips, second views, archival visits, exhibit reservations, or interactive experience enrollments. Interpretive quality was rated by three coders on four criteria: whether it explains character relationships, whether it explains the significance of the process, whether it explains cultural sources, and whether it leads back to the core text. Each item was rated on a scale of 0-2, averaged and normalized. All strategy groups were resampled 1000 times with bootstrap, and means and 95% confidence intervals were reported. Pairwise tests were used to assist in determining differences between strategies within the same work, but the main text interpreted the results in terms of effect sizes and confidence intervals to avoid misclassifying platform distribution fluctuations as strategy differences. The test protocol revolves around strategy grouping, dissemination window and evaluation reading, and the specific mechanism is shown in Figure 3.

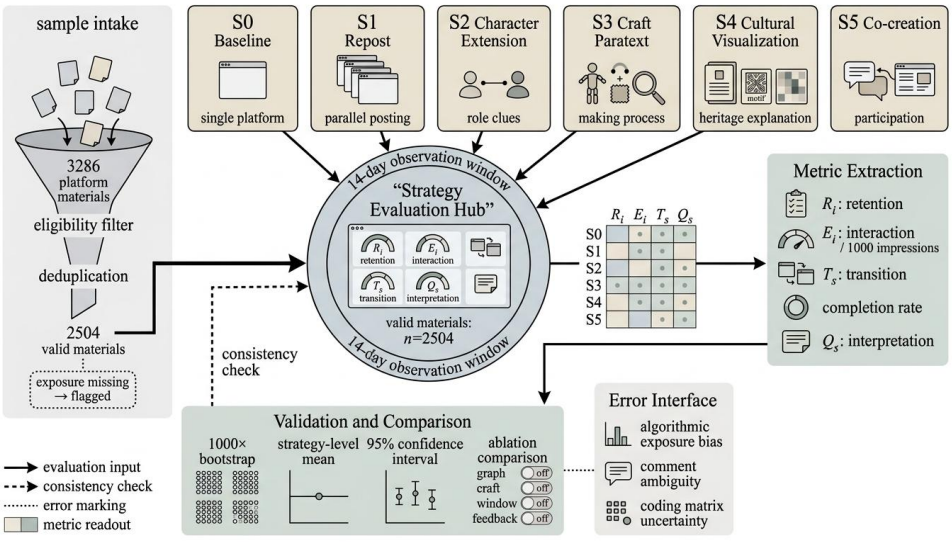

Figure 3: Experimental Protocol and Evaluation Methodology.

The experimental protocol and data cleaning criteria are shown in Table 3.

Table 3: Experimental Protocol and Data Cleaning Criteria

Segment	Execution Criteria	Retention Standards	Output Objects
Communication Window	14 Days Post-Release	Obtainable Release Time and Interaction Data	Interaction Intensity, Completion Rate
Media Classification	Six Categories of Media	Clear Content Forms and Release Scenarios	Media Nodes
Conversion Identification	Clicks, Re-watches, Archive Access, Sign-ups	Can Be Linked to the Same Work or Narrative Unit	Conversion Rate
Quality of Explanation	Rated by Three Coders	At Least Two Coders Must Agree	$(Q_s$
Error Handling	Estimated Median Exposure on Platform	Missing Exposure but Retaining Interaction Records	Mark Estimated Source

3 Results and Discussion

3.1 The Coupling Relationship Between Narrative Elements and Media Formats

There is a clear division of labor in the communication materials of puppet animation: the main film takes on characters and events, the short video takes on movement and craftsmanship, the digital archive takes on cultural interpretation, and the exhibition and VR/AR scenes take on the physical scale and puppet manipulation experience. A review of AR, VR, and mixed reality in the cultural heritage field shows that immersive media have a strong fit in cultural heritage experience, education, and on-site interpretation [26]. In the puppet animation sample, this adaptability was specifically demonstrated by differences in the coupling of material, action, and scene information to different media. A heat map of the coupling of narrative elements to media vehicles is shown in Figure 4.

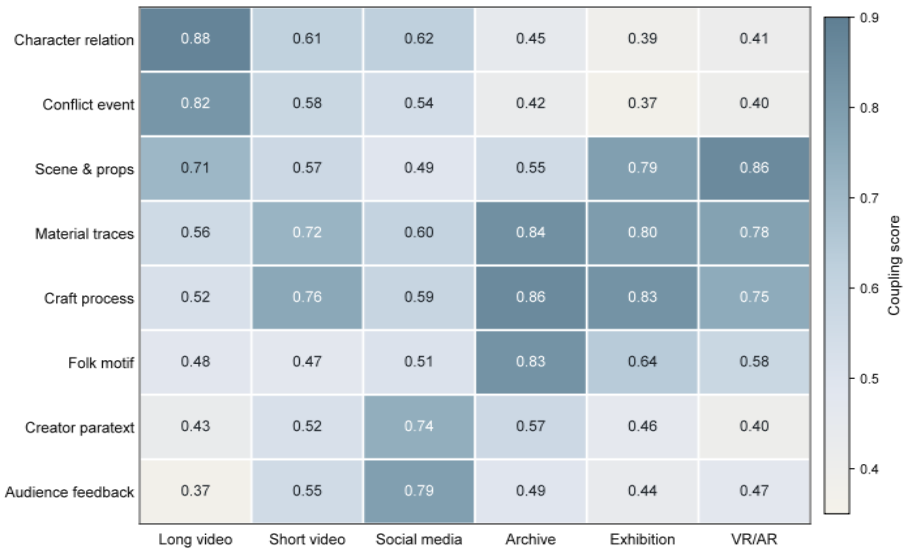

Figure 4: Heatmap of the coupling between narrative elements and media formats.

In Figure 4, long videos have the highest coupling scores of 0.88 and 0.82 for character relationships and conflict events respectively, indicating that full-length positives and long clips are still the core carriers for maintaining the story's main axis. The coupling scores of short videos on craft process and material traces are 0.76 and 0.72 respectively, which are higher than their 0.47 on folklore main theme, indicating that short videos are more suitable for presenting production content with strong visibility, clear action and lower explanation cost. The coupling scores of social media on audience feedback and creator subtext are 0.79 and 0.74, respectively, indicating that character accent copy, creator instructions and comment interactions are more likely to form topics in social spaces.

The coupling scores of digital archives on process, material traces and folklore motifs are 0.86, 0.84 and 0.83 respectively, which are the most stable carriers of knowledge interpretation among all media. The coupling scores of exhibition to process and material traces are 0.83 and 0.80, and to scene and props are 0.79, indicating that offline space can complement the sense of scale and object details that are difficult to be presented by screen viewing.The coupling scores of VR/AR experience to scene and props are the highest, 0.86, and to material traces and process, 0.78 and 0.75, showing that the immersive medium is more suitable for the transformation of manipulatives. immersive medium is more suitable for transforming puppet movements, spatial relationships and prop orientation.

This result suggests that the cross-media communication of puppet animation needs to allocate the medium according to the narrative function. Character relationships and conflict events should be stabilized by the main film or long video clips to avoid excessive fragmentation in the short video stage. Materials, craftsmanship and frame-by-frame movement can enter the short video and exhibition space, assuming the function of "seeing the production". Folklore motifs and cultural sources are suitable for digital archives and graphic pages, assuming the function of "explaining sources".

Audience comments and secondary tasks are suitable for social media, but need to be directed back to the core text through character cues or archival links. Thus, the number of platforms is not a sufficient condition for the effectiveness of cross-media communication, but rather the relationship between the media and the narrative units is the basis of strategy design.

3.2 The Relationship Between Communication Strategy Effectiveness, Cross-Media Conversion, and Three-Dimensional Response

Having clarified the coupling relationship between narrative elements and media platforms, this section compares the overall effectiveness of six types of communication strategies. Interactive digital storytelling in cultural heritage applications emphasizes the synergy among story segments, interactive tasks, and immersive experiences [27]; research on digital storytelling in local cultural spaces also suggests that narrative forms need to align with spatial and media contexts [28]. Accordingly, this paper focuses the strategy comparison on four indicators: whether the narrative is retained, whether the audience interacts, whether cross-media entry points are converted, and whether the quality of interpretation is sufficient to support cultural understanding. The results of the strategy comparison are shown in Table 4.。

Table 4: Comparison of the effectiveness of communication strategies

Strategy Group	Narrative Retention	Interaction Intensity (per 1,000 Impressions)	Cross-Media Conversion Rate (%)	Completion Rate (%)	Explanation Quality	Overall Score
S0 Single Platform Baseline Release	0.51	7.4	3.1	64.2	0.43	0.447
S1 Parallel Transfer	0.57	9.1	4.6	66.8	0.46	0.512
S2 Character Clue Extension	0.69	12.8	7.9	73.4	0.61	0.638
S3 Material and Craft Subtext	0.72	15.6	8.7	76.1	0.74	0.691
S4 Cultural Knowledge Visualization	0.77	14.2	10.5	78.3	0.83	0.724
S5 Audience Participatory Co-creation	0.66	18.9	12.3	69.5	0.62	0.704

A multi-metric comparison of the six types of strategies is shown in Figure 5.

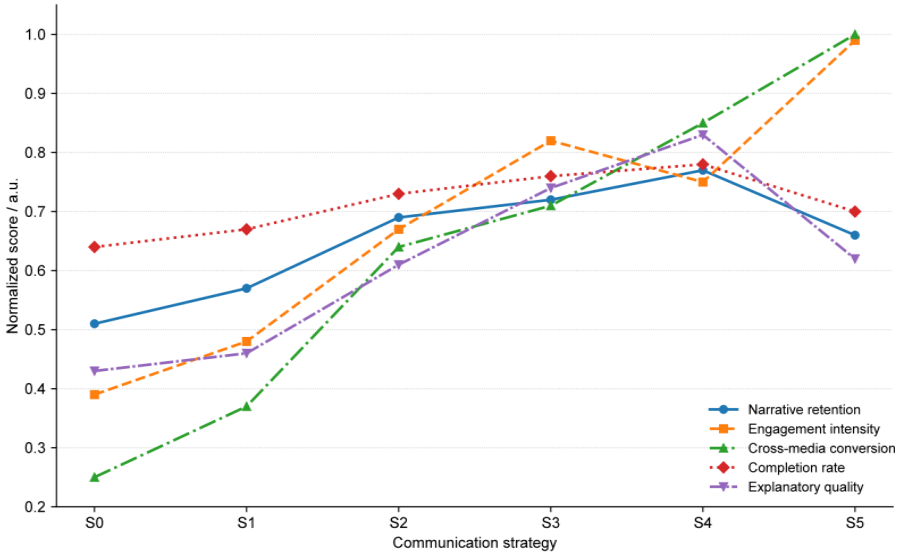

Figure 5: Comparison of cross-media communication strategies across multiple indicators.

In Figure 5, the curves of S0 and S1 are in the lower range: S0 has a composite score of 0.447 and a cross-media conversion rate of 3.1%; S1, after carrying the same piece of content to multiple platforms, the intensity of interactions increased from 7.4 to 9.1 per thousand exposures, but the conversion rate only increased to 4.6%, with a composite score of 0.512. This suggests that multi-platform publishing of the same piece of content is able to increase the

exposure, but it is difficult to create a narrative extension. This shows that multi-platform distribution of the same clip can increase reach, but it is difficult to create narrative extension. When viewers see duplicate content on different platforms, they lack a reason to go to the main movie, archive or exhibition page.

The curves of S2, S3, and S4 are closer to the pattern of "simultaneous increase in narrative retention and interpretive quality." S2 achieves a narrative retention of 0.69 and a completion rate of 73.4% through the extension of character tone, character motivation, and character relationships; S3 converts puppet expression substitution, articulation tuning, fabric texture, and frame-by-frame filming into paratext, with an interactive intensity of 1,000 views per thousand; and S3 achieves an interactive intensity of 1,000 views per thousand. S4 has the highest overall score of 0.724, with a narrative retention of 0.77, a cross-media conversion rate of 10.5%, and an interpretive quality of 0.83. The advantage of cultural knowledge visualization is that it is able to transform folklore motifs, prop sources, and craft genealogies into retrievable, lingering, and revisitable pages, reducing the audience's ability to understand cultural sources. pages, reducing the cost of understanding cultural sources for the audience.

S5 has the highest interaction intensity of 18.9 per 1,000 exposures and a cross-media conversion rate of 12.3%, but the narrative retention of 0.66 is lower than that of S3 and S4.This result suggests that the co-creation task can effectively stimulate commenting, re-tweeting, and secondary participation, but without the constraints of character relationships, craftsmanship explanations, and cultural origins, the viewer-generated content can easily shift to general entertainment expression. For puppet animation, the co-creation strategy is more suitable to be placed in the latter part of the communication chain: after the audience already understands the characters and craftsmanship, then opening up the characters for rewriting, props redesign and puppet manipulation experience can reduce the dilution of the core narrative.

Cross-media communication also depends on the transformation paths between different entry points. Studies of interactive documentaries on cultural heritage have shown that audience engagement is not a single point of clicking behavior, but a continuous process consisting of viewing, understanding, interaction, and revisiting [29].

To test the flow of entrances in puppet animation communication, this paper calculates the effective hopping rate between six types of media, and the results are shown in Fig. 6.

Figure 6: Cross-media portal conversion matrix.

In Figure 6, the conversion rate from digital archive to long-form video is the highest at 35.0%, therefore it suggests that when the archive page makes explanation of characters, craft skills and culture origins, viewers have higher possibility to go back to the main movie to get the complete story. Among all VR/AR experience projects, 34.0% are finally transformed into exhibition works; 33.0% of short-form videos are transformed into social media content; and 31.0% of long-form videos are transformed into short-form videos. These roads indicate that cross-medium transformations do not always extend outwards starting from the core movie, but may also be turned around by an archive, an exhibition, or an interactive experience which conducts the viewer returning to the text of the picture. The 29.0% transformation rate from social media to short-form video indicates that comment strings and character mood words can push watchers to go on to watch the making process or action segments. The 31.0 percent transformation ratio from exhibition to digital data store indicates that after looking at the real item under line, audiences still require further obtaining of craft and cultural introduction. For the sake of further observing the relation among media diversity, narrative retention and interaction intensity, this paper draws a three-dimensional response surface, which is shown in Figure 7.

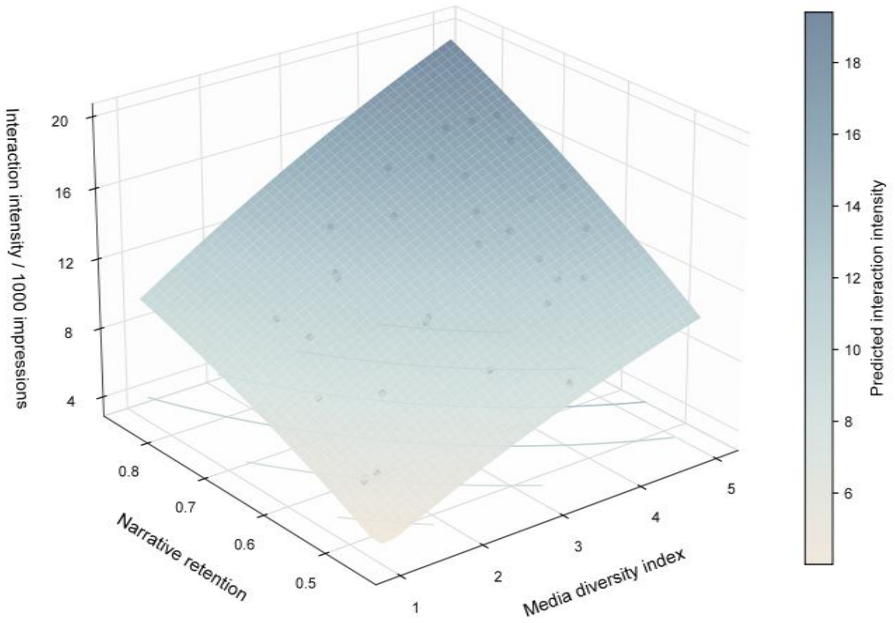

Figure 7: Three-Dimensional Response Surface for Media Diversity, Narrative Retention, and Interaction Strength.

In Figure 7, interaction intensity rises with the simultaneous increase of media diversity and narrative retention. When the media diversity index is lower than 2.0 and the narrative retention is lower than 0.55, the interaction intensity is mainly centered on less than 11 times per 1,000 exposures; when the media diversity index exceeds 4.0 and the narrative retention exceeds 0.75, the surface prediction value is close to 23 times per 1,000 exposures. This result suggests that multi-media publishing translates into stable interactions only when narrative retention is high. The surface does not increase significantly if the media type increases but the content is repetitive, and the interaction intensity is limited if the narrative retention increases but the number of entries is too small. Effective strategies require two conditions to be met simultaneously: that the mediums assume a differentiating function from one another, and that the communication material still returns to the character, event, craft, or cultural motif.

3.3 Module Ablation, Case Explanation and Deployment Strategy

The previous two sections show that the effectiveness of cross-media communication of puppet animation relies on the matching of narrative units to media vehicles. This section further examines the contribution of modeling modules and explains strategy differences through a case release window. Studies of immersive digital museums have shown that the combination of virtual and social interactions improves the visiting experience [30]; this finding is manifested in puppet animation dissemination in that viewers need both viewable image portals and manipulable, interpretable, and re-created content interfaces. A comparison of module dissolution and efficiency is shown in Figure 8.

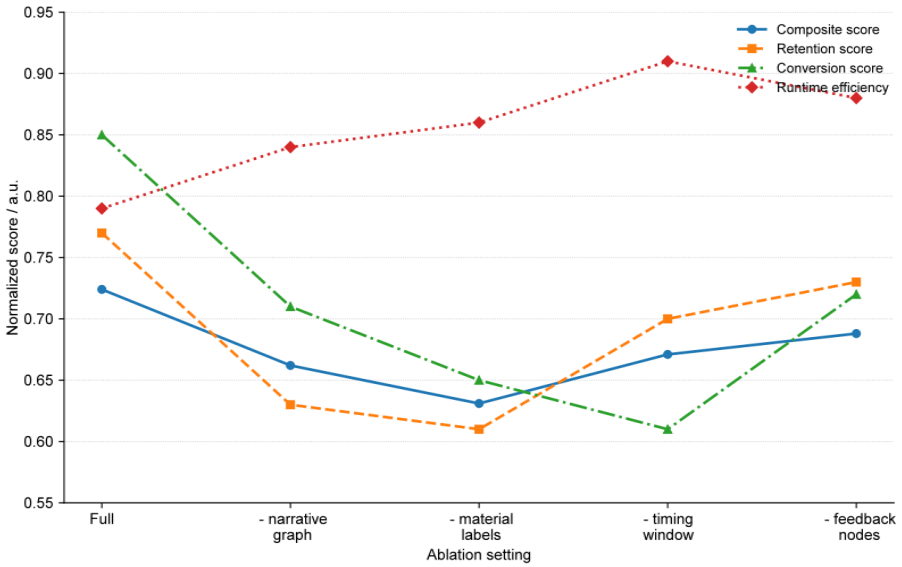

Figure 8: Comparison of module ablation and efficiency.

The results of the module ablation and operational efficiency are shown in Table 5.

Table 5: Results of module ablation and operational efficiency

Setting	Overall Score	Narrative Retention Score	Conversion Score	Average Processing Delay (ms)	Operational Efficiency
Complete Model	0.724	0.77	0.85	184	0.79
Without Narrative Map	0.662	0.63	0.71	163	0.84
Without Material Craft Labels	0.631	0.61	0.65	158	0.86
Without Platform Time Window	0.671	0.70	0.61	142	0.91
Without Audience Feedback Node	0.688	0.73	0.72	151	0.88

In Figure 8 and Table 5, the composite score after removing the material and process labels decreased from 0.724 to 0.631, or 12.8%; the narrative retention score decreased from 0.77 to 0.61, and the transformation score decreased from 0.85 to 0.65. This is the largest change, which suggests that the material and process are not peripheral to the communication of the puppet animation. The puppet's replacement faces, joint movements, fabric textures, and frame-by-frame traces were able to lead the viewer from "seeing the character" to "understanding how

the character was made," which in turn increased the transformative power of the short video, the archive, and the exhibit.

After removing narrative mapping, the composite score dropped to 0.662, a decrease of 8.6%. This result suggests that the relationships between characters, events and cultural matrices can easily turn communication materials into isolated fragments if they are not explicitly modeled. After we have gotten rid of the platform time window, the conversion score has dropped from 0.85 to 0.61, which hence shows that the order of media succession and release time possess a remarkable influence on cross-media conversion. After we take out the audience feedback node, the comprehensive score drops to 0.688, with a corresponding falling of interaction strength, hence it shows that comment chains and secondary creation clues can offer a foundation for correction of follow-up issue releases. From the perspective of operation efficiency, the average processing delay of the complete model is 184 ms, this value is lower than the second response threshold which real-time recommendation systems usually pay attention to, hence can support the batch assessment of communication materials; The ablation model, although it has a lower delay, it sacrifices narrative interpretation and conversion judgment. The case dissemination window further illustrates the strategy differences. In this paper, we select three types of typical communication chains: staged cross-media release, parallel carry, and single-craft subtext, and count the change in interaction intensity over a 14-day window, as shown in Figure 9.

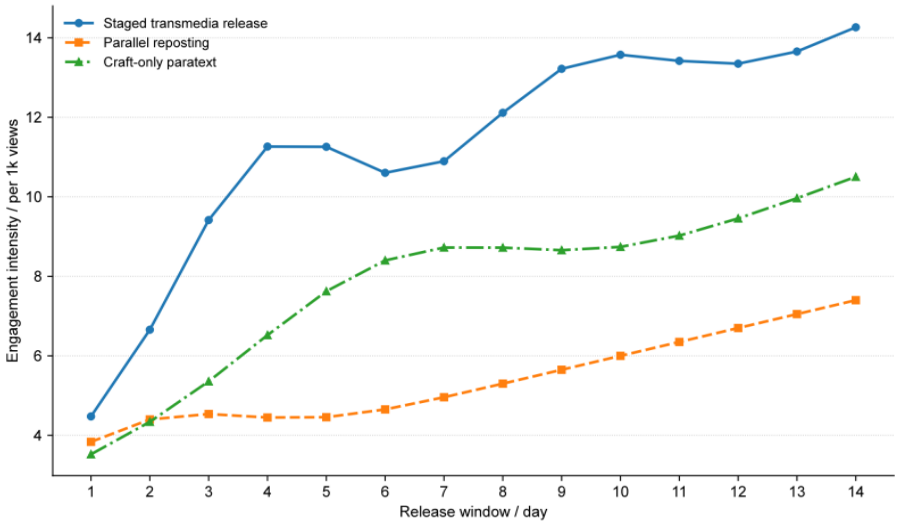

Figure 9: Interaction Curve for the Case Study Release Window.

In Figure 9, the staged cross-media posting shows two peaks of interaction on days 4 and 9. The first peak comes from the short-video crafted paratext release, and the second peak comes from the succession of digital archive pages and social topics. The curve reaches about 15 exposures per thousand on day 14, which is significantly higher than the parallel carry curve. Parallel carry shows a small increase in the first 2 days, then slows down to an interaction intensity of less than 8 per 1,000 exposures on day 14. The single-craft subtext had a peak on day 6, but the subsequent lack of character and cultural interpretation portals made it difficult to sustain the growth in interactions. This case illustrates the need for puppet animation communications to combine release time series with narrative features. Craft content is suitable for release after the main movie or character clips, archival explanations are suitable for access after viewers have developed an interest in the material, and co-creation tasks are suitable for opening up after both the characters and the craft are understood.

Synthesizing these results, five deployment strategies can be developed for cross-media

dissemination of puppet animation narratives. First, anchoring character relationships and conflict events in positive or long video clips ensures that viewers can recognize the main story axis. Secondly, putting material and craft subtexts into short videos and exhibition spaces, focusing on presenting replacement faces, joint tuning, fabric textures, prop scales, and frame-by-frame filming, so that traces of craftsmanship become part of the narrative interpretation. Third, cultural matrices, prop sources and production genealogies are put into digital archives, graphic pages and museum pages to form a searchable and returnable knowledge portal. Fourth, social media should not just post posters and slogans, but should carry character accents, creator notes, comment quizzes and second creation tasks. Fifth, VR/AR experiences should be designed around manipulative puppet movements, spatial relationships, and prop interactions, avoiding only converting positive scenes to 3D displays.

The sequence that these strategies are put into use also needs to be controlled by people. A more consistent order should be: the full-length movie or film material sets up the characters and things at first, the short clip then interprets the content and the making flow, public network platforms carry the characters' style and make comments and interactions, the digital storage warehouse supplements the culture resources, the exhibition and VR/AR give the actual size and the immersive experience, and at last, it opens to the task of joint creation. This order lessens the using up of the story center by broken content and hence permits the slow change of materials, working steps and cultural patterns into things that can be understood, attractive and passable content supplies for the people watching.

4 Conclusion

This paper focuses on the cross-media communication of puppet animation narratives, constructs a digital humanities analytical framework, organizes the text of works, platform communication materials, production processes, cultural motifs and public comments into a narrative media isomorphism, and evaluates the communication strategies through the degree of narrative retention, media coupling, interactive intensity, cross-media conversion rate and interpretive quality.

(1) At the level of object organization, this paper constructs a sample library containing 68 works, 3286 platform communication materials and 42,615 public comments, and establishes a coding system for characters, events, spaces, materials, cultural matrices and feedback themes, so as to bring the physical materials, production processes and cultural sources of puppet animation into computable analysis.

(2) At the method and result level, the cultural knowledge visualization strategy had the highest composite score of 0.724; the interactive intensity of the material and process paratexts reached 15.6 per 1,000 exposures; and the cross-media conversion rate of audience participatory co-creation reached 12.3%. The ablation results showed that the composite score decreased by 12.8% after removing the material-craft label, indicating that materiality interpretation is a key module in the cross-media communication of puppet animation.

(3) This paper is still limited by public sample size, platform exposure estimation and comment semantic identification. Follow-up studies can expand the puppet animation samples from different regions and languages, introduce multimodal identification, audience experiments, and long-term communication tracking to test the stability of the framework in non-heritage communication, animation distribution, and cultural tourism exhibition scenarios.

About the Author

Jing Wu was born in Putian，Fujian. P.R. China, in 1997. She obtained a Master's degree from RMIT University in Australia. I am currently working at the School of Art and Media, Fujian Forestry Vocational and Technical College. My main research areas are Digital Humanities and Puppet Animation.

References

[1] Maselli, V. (2024). Puppets' tales: New design perspectives for a multimedia archive of a humanity's intangible heritage. In Multidisciplinary Aspects of Design: Objects, Processes, Experiences and Narratives (pp. 65-74).

[2] Maselli, V. (2018). The evolution of stop-motion animation technique through 120 years of technological innovations. International Journal of Literature and Arts, 6(3), 54-62.

[3] Wells, P. (2014). Chairy tales: Object and materiality in animation. Alphaville: Journal of Film and Screen Media, 8, 6-23.

[4] Maselli, V. (2024). Narrating fabrics: Nostalgia in animated puppets' skin. Animation, 19(1), 27-42.

[5] Eivazy, N., Peeters, J. P. L., & Claes, S. (2023). Connecting through objects: Sharing memories through participatory stop-motion animation with personal objects of the Armenian diaspora. In Proceedings of the 11th International Conference on Communities and Technologies (pp. 48-53).

[6] Jenkins, H. (2010). Transmedia storytelling and entertainment: An annotated syllabus. Continuum: Journal of Media & Cultural Studies, 24(6), 943-958.

[7] Scolari, C. A. (2009). Transmedia storytelling: Implicit consumers, narrative worlds, and branding in contemporary media production. International Journal of Communication, 3, 586-606.

[8] Adams, C., & Barbour, K. (2022). Transmedia storytelling, diegetic paratexts, and the limits of real time. Convergence: The International Journal of Research into New Media Technologies, 28(6), 1515-1530.

[9] Sánchez-López, I., Pérez-Rodríguez, A., & Fandos-Igado, M. (2020). The explosion of digital storytelling: Creator's perspective and creative processes on new narrative forms. Heliyon, 6(9), e04809.

[10] Psomadaki, O. I., Dimoulas, C. A., Kalliris, G. M., et al. (2019). Digital storytelling and audience engagement in cultural heritage management: A collaborative model based on the digital city of Thessaloniki. Journal of Cultural Heritage, 36, 12-22.

[11] Way, D.-L., & Wei, Y.-H. (2023). Use of cloud-based virtual reality in Chinese glove puppetry to preserve intangible cultural heritage. Applied Sciences, 13(9), 5699.

[12] Kasemsarn, K., & Nickpour, F. (2025). Digital storytelling in cultural and heritage

tourism: A review of social media integration and youth engagement frameworks. Heritage, 8(6), 200.

[13] Hogan, A., Blomqvist, E., Cochez, M., et al. (2021). Knowledge graphs. ACM Computing Surveys, 54(4), 71.

[14] Liem, J., Kusnick, J., Beck, S., et al. (2023). A workflow approach to visualization-based storytelling with cultural heritage data. In 2023 IEEE 8th Workshop on Visualization for the Digital Humanities (pp. 13-17).

[15] Mayr, E., Windhager, F., Liem, J., et al. (2022). The multiple faces of cultural heritage: Towards an integrated visualization platform for tangible and intangible cultural assets. In 2022 IEEE 7th Workshop on Visualization for the Digital Humanities (pp. 13-18).

[16] Segel, E., & Heer, J. (2010). Narrative visualization: Telling stories with data. IEEE Transactions on Visualization and Computer Graphics, 16(6), 1139-1148.

[17] Panagiotidou, G., Lamqaddam, H., Poblome, J., et al. (2023). Communicating uncertainty in digital humanities visualization research. IEEE Transactions on Visualization and Computer Graphics, 29(1), 635-645.

[18] Lee, B., Riche, N. H., Isenberg, P., et al. (2015). More than telling a story: Transforming data into visually shared stories. IEEE Computer Graphics and Applications, 35(5), 84-90.

[19] Tong, C., Roberts, R., Borgo, R., et al. (2018). Storytelling and visualization: An extended survey. Information, 9(3), 65.

[20] McKenna, S., Riche, N. H., Lee, B., et al. (2017). Visual narrative flow: Exploring factors shaping data visualization story reading experiences. Computer Graphics Forum, 36(3), 377-387.

[21] Blondel, V. D., Guillaume, J.-L., Lambiotte, R., et al. (2008). Fast unfolding of communities in large networks. Journal of Statistical Mechanics: Theory and Experiment, 2008(10), P10008.

[22] Bastian, M., Heymann, S., & Jacomy, M. (2009). Gephi: An open source software for exploring and manipulating networks. Proceedings of the International AAAI Conference on Web and Social Media, 3(1), 361-362.

[23] Kietzmann, J. H., Hermkens, K., McCarthy, I. P., et al. (2011). Social media? Get serious! Understanding the functional building blocks of social media. Business Horizons, 54(3), 241-251.

[24] Treem, J. W., & Leonardi, P. M. (2013). Social media use in organizations: Exploring the affordances of visibility, editability, persistence, and association. Communication Yearbook, 36, 143-189.

[25] Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of social media. Business Horizons, 53(1), 59-68.

[26] Bekele, M. K., Pierdicca, R., Frontoni, E., et al. (2018). A survey of augmented, virtual, and mixed reality for cultural heritage. ACM Journal on Computing and Cultural Heritage, 11(2), 7.

[27] Rizvic, S., Boskovic, D., & Mijatovic, B. (2024). Advanced interactive digital storytelling in digital heritage applications. Digital Applications in Archaeology and Cultural Heritage, 33, e00334.

[28] Chrysanthi, A., Katifori, A., Vayanou, M., et al. (2021). Place-based digital storytelling: The interplay between narrative forms and the cultural heritage space. In Emerging Technologies and the Digital Transformation of Museums and Heritage Sites (pp. 127-138).

[29] Podara, A., Giomelakis, D., Nicolaou, C., et al. (2021). Digital storytelling in cultural heritage: Audience engagement in the interactive documentary New Life. Sustainability, 13(3), 1193.

[30] Alabau, A., Fabra, L., Martí-Testón, A., et al. (2024). Enriching user-visitor experiences in digital museology: Combining social and virtual interaction within a metaverse environment. Applied Sciences, 14(9), 3769.