SN Business & Economics (2026) 6:169
https://doi.org/10.1007/s43546-026-01181-x

RESEARCH

Revitalizing shaanxi shadow puppetry through digital engagement and youth participation

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Received: 13 March 2026 / Accepted: 6 May 2026

Abstract

Digital media is redefining the communication landscape. This change revolutionises how people share cultural heritage and viewers. In the modern world, Shaanxi shadow puppetry is taking the turn to digital platforms. This research paper looks at how modern technology can facilitate sustainable development of this art. It also emphasises the importance of maintaining cultural authenticity. This work is based on the theory of Lotmans Semiosphere. The author used qualitative research and semi-structured interviews. It was interviewed 30 art students, 3 researchers, and 4 shadow puppeteers. Interview data obtained were sorted and coded using the NVivo 15 software, and the outcomes showed that some variables enhanced youth participation. They include interactive online experiences, deliberated visual design, and different digital conservation applications. The findings presented here form the basis of a Digital Living Inheritance framework that is introduced in this paper. This framework gives a fresh focus to the preservation of Shaanxi shadow puppetry. It creates a sense of cultural identity among the young people and creative reproduction of the art.

Keywords Digital cultural heritage · Shaanxi shadow puppetry · Semiosphere theory · VR/AR · Interactive media · Immersive technologies · Digital preservation

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Published online: 18 May 2026

Introduction

One prominent example of Chinese folk art is Shaanxi shadow puppetry. It possesses deep cultural roots and aesthetic value. In 2011, the UNESCO included Chinese shadow puppetry on the Representative List of the Intangible Cultural Heritage of Humanity (UNESCO, 2011). Shaanxi East Road Shadow Play is one that is specifically famous in this tradition. It is a cultural treasure because of fine carving and advanced performance. It is an art form that has combined folk art, music, and oral literature to protect local memories. However, new challenges to this tradition include the digital era. Media trends are changing and shadow puppetry is being threatened with extinction. The listeners are ageing, and the young people are not exposed to much of the arts. This presents a generational divide. Shaanxi East Road Shadow Play is a traditional form of Chinese shadow puppetry with deep historical and cultural roots. Originating from the Shaanxi region, it represents one of the most distinctive regional variations of shadow performance art characterized by its intricate leather carving techniques, stylized silhouettes, and narrative storytelling traditions. Historically, it has played a significant role in local cultural life, functioning both as entertainment and as a medium for transmitting folk beliefs, moral narratives, and collective memory. Despite modernization and changing media environments, Shaanxi East Road Shadow Play continues to hold cultural significance as an intangible heritage form, reflecting the artistic identity and historical continuity of the region within a broader global heritage context.

The recognition of shadow puppetry as part of the UNESCO Intangible Cultural Heritage of Humanity provides important global validation of its cultural and artistic significance. In the context of Shaanxi East Road Shadow Play, this acknowledgment reinforces its status not only as a local traditional performance form but also as a heritage practice of international relevance. However, despite this recognition, challenges remain in ensuring its effective transmission and engagement with younger generations in contemporary digital environments.

Our local troupes are perishing out of lack of successors. Research shows that shadow puppetry faces low market demand and outdated transfer strategies. The art form will, therefore, be forced to find a way of recontextualising itself to the present society. At the same time, as technology advances rapidly, access to culture changes. Young individuals tend to lean towards digital media and interactive content experiences. The scope of common propagation media can be often constrained by physical theatres and geography. The contemporary digital world insists on intangible heritage to oppose such boundaries. New platforms to support youth cultural identity must be established.

Current digital practices for heritage often focus on technical recording and video archives. These projects aim to save skills “objectively” through virtual museums or high-fidelity media. These efforts provide a foundation for data storage. However, they usually rely on one-way communication. Most projects fail to build a structured path for living inheritance. The 2003 UNESCO Convention emphasizes that heritage protection must involve active communities. In the digital age, the participation of young people remains neglected. Digital influence refers to how online interactions and content shape user perceptions and decision-making within social media envi-

ronments. Social structures in networks determine how information flows, highlighting key actors who drive engagement and diffusion. Social network analytics enables advertisers to identify influential nodes, patterns, and communities for targeted marketing strategies. Together, these elements enhance advertising management by improving precision, reach, and effectiveness of promotional campaigns.

This study focuses on Shaanxi shadow puppetry and uses semi-structured interviews. It explores a digital protection path for young audiences. The research aims to build a Digital Living Inheritance framework based on qualitative data. This framework seeks to give traditional art new vitality and offer innovative ideas for engaging the younger generation. This study advances heritage science and digital humanities by proposing a Digital Living Inheritance framework that operationalizes Semiosphere theory into a structured, interactive digital transformation model. Unlike prior work focusing on static preservation, this study introduces a participatory, youth-centred mechanism integrating symbolic re-coding, immersive media, and co-creative engagement.

Literature review

Research on the digital preservation of intangible cultural heritage

In recent years, the digital preservation of intangible cultural heritage has become a focus of global academic attention (ihchina, 2006).

In recent years, the digital preservation of intangible cultural heritage has become a focus of global academic attention. International organizations, represented by UNESCO, have been promoting digital preservation and dissemination programs, advocating the use of cutting-edge technologies to systematically record and preserve endangered heads and intangible cultural expressions, and ensuring their long-term transmission through digital archives (Ardiyan & Syamsuddin, 2019).

Existing literature highlights that digital influence in social media significantly shapes consumer attitudes through peer interactions and content sharing dynamics. Studies on social structures in networks show that information diffusion is strongly affected by central nodes, clusters, and community patterns. Social network analytics has been widely used to measure influence, engagement, and the effectiveness of digital marketing strategies. Overall, prior research suggests that integrating network analysis into advertising management improves targeting accuracy and campaign performance.

In China, significant achievements have also been made in the digital protection of cultural heritage. Under the guidance of national policies, China has been continuously advancing in areas such as cultural heritage image collection, digital museum construction and database systems. Cultural institutions and researchers in various regions have also been actively exploring more localized and interactive digital protection paths. Digital media technology, virtual reality and database technology should record cultural heritage materials comprehensively to achieve the full presentation and remote sharing of information (Dang et al. 2021). Digital exhibitions are becoming increasingly important as a means of inheritance. Digital exhibitions are

gradually becoming the mainstream form of heritage exhibitions. However, it is also necessary to pay attention to the accuracy and interactivity of the exhibition content in order to establish a two-way information exchange channel and achieve living inheritance.

Research on shaanxi shadow puppetry

The study of shadow puppetry focuses on its distinct creative expression, technological system, current distribution status, and cultural symbolic meaning. Scholars have noted that shadow puppetry combines elements such as visual modeling, music singing, and tale presentation. Its artistic expression stresses the combination of silhouette beauty and detailed carving, and it frequently employs the design of alternating openwork and solid to demonstrate the beauty of the interplay between the real and virtual (Chen, 2007). Taking Shaanxi shadow puppetry as an example, the carving technique of its Huaxian school is known as "pushing the shadow puppet into the shape of a knife". It uses white wood as a medium to carve delicate patterns, which reflects excellent handicraft skills. In addition, the performance of Shaanxi shadow puppetry has given birth to a variety of singing styles, such as stringed instrument singing, bowl singing, and Agong singing, which show the integration of local opera and folk music, forming a rich artistic spectrum (Poulopoulos & Wallace, 2022). At the level of cultural symbols, the character design, plot themes, and folk rituals of Shaanxi shadow puppetry contain profound symbolic meanings and are important ways to understand regional cultural beliefs and historical memories (Guo, 2025). Online customer engagement is a key concept in digital marketing that explains how users interact with online content and brands. Engagement mechanisms operate through user responses such as clicks, shares, comments, and time spent on content. These interactions act as indicators of audience interest and behavioural involvement in digital platforms (Wiggins 2022).

However, under the impact of modern society and the new media environment, the survival space of Shaanxi cinema is facing challenges. This reality provides contextual support for the analysis of the post-cultural center-marginal structure.

Cultural identity and digital media consumption among young audiences

Research on cultural identity and digital consumption behavior among young people has found that digital media has become an important bridge connecting young people with traditional culture. As digital natives, those born in the 1990s and 2000s are already accustomed to obtaining cultural information through the internet and interactive media. Digital platforms have thus become an important medium for them to access, understand, and even recreate traditional culture (Huang 2015; Xiong and Zhao 2020). I For example, virtual exhibitions and "digital museums" can effectively stimulate young audiences' interest in traditional culture and promote their identification at the cognitive, emotional, and practical levels. The popularity of digital cultural products may not necessarily lead to long-term cultural attention and understanding. How to transform the superficial interest of young people into lasting and deep cultural identity remains an important challenge in the dissemination of cul-

tural heritage. In recent years, forms such as animation, gamified inheritance, and short videos with cultural heritage themes have emerged one after another, providing new breakthroughs for cultural heritage dissemination models and becoming a cutting-edge issue of concern to the academic community. While the aforementioned research on the digitization of cultural heritage and its young audience has revealed dissemination channels and audience characteristics, it still falls short in explaining the mechanisms of the integration of traditional culture and emerging media systems. The "boundary-recoding" mechanism of symbolic domain theory can fill this gap, providing a systematic explanatory path for the dynamic translation of cultural heritage in the digital environment (Li, 2022; Meng, 2024).

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Application of the Semiosphere Theory in Cultural Heritage Protection Research

Semiosphere theory conceptualizes culture as a dynamic semiotic space in which signs and symbols interact to generate meaning. Within this space, cultural elements do not function in isolation but gain significance through their relationships and positioning within a larger symbolic system. Meaning is continuously shaped through interaction between cultural codes, communicative practices, and social contexts. Thus, the Semiosphere provides a framework for understanding how cultural heritage is constructed, transformed, and interpreted through evolving symbolic exchanges. This theory breaks through the traditional approach of studying culture based on a single text, and instead examines the operating mechanism of the cultural system from a macroscopic perspective. In the semiotics, different symbolic systems interact and translate with each other to jointly shape the overall order and meaning of culture. While Semiosphere theory conceptualizes boundary and re-coding as processes of cultural translation, this study extends the theory by operationalizing these mechanisms within interactive digital ecosystems. In this context, "re-coding" is not treated as a simple transformation of symbolic forms into digital representations, but as a participatory and iterative process shaped by user interaction, platform affordances, and youth-driven reinterpretation. Similarly, the "core–periphery" structure is reinterpreted as a dynamic and fluid configuration in which marginalized cultural forms can re-enter the cultural core through digital engagement and co-creation. This reconceptualization extends the theory from static symbolic translation to dynamic cultural regeneration in digital environments.

Conceptual accessibility is improved by simplifying the boundary–re-coding mechanism into three sequential steps. First, symbolic boundaries are identified, where traditional cultural elements are distinguished from external digital systems based on differences in form, function, and context. Second, boundary translation occurs, in which these elements are adapted into digital-compatible representations while preserving their core cultural meaning. Third, re-coding is applied, where

transformed symbols are structured into digital formats such as 3D models, metadata, or interactive media content. For example, a shadow puppet character originally existing as a physical carved object is first digitized through scanning, then visually adapted into a digital model, and finally integrated into a VR or animation platform for user interaction.

1) Symbolic Boundary Mechanism. Boundary" is a fundamental concept in semiotics. Boundaries serve not only as a demarcation device, but also as a "translator" of new information into a cultural system. Only through boundary transformation can new symbols be incorporated and given new meanings . This mechanism is especially important in the preservation of non-material cultural heritage. Taking Shaanxi film as an example, the character design, singing system, and performance logic form a relatively stable cultural core, whereas digital technologies (such as 3D modeling, virtual performances, and short video dissemination) as external symbol systems must negotiate and translate boundaries when entering the traditional context of film. For example, the characters in a virtual exhibition hall must be changed from two-dimensional planes to three-dimensional dynamic representations, a process known as boundary translation.
2) Re-coding mechanism. Re-coding is one of the core mechanisms of symbol domain operation. Lotman points out that if external symbols are to be integrated into the existing cultural system, they must be re-encoded to achieve semantic fit and rationality. In the digital practice of Shaanxi Film Studio, this mechanism is manifested in multi-level cultural translation: traditional silhouette figures are digitized into operable three-dimensional figures; singing styles such as Wanwanqiang and Xianbanqiang are re-recorded and edited to conform to the dissemination rhythm of contemporary media; the performance viewing style is also redesigned on the interactive platform. These re-encoding processes not only maintain the core characteristics of film symbols, but also enhance their expressiveness and communicability through digital technology. The technical nature of the study is framed through the process of re-encoding culture in digital form, conceptualized as a systematic transformation pipeline in which elements of traditional culture undergo an organized translation into computer-interpretable formats. In particular, the process starts with the digitization of physical artefacts such as the form of puppets used and carving techniques. Symbolic properties such as the identity of characters, roles, motifs, and actions are next extracted and encoded in structured digital forms including data models and metadata schemas. Finally, the digital encoding of symbols can be applied to different kinds of media, including virtual worlds, interactive applications, and animation. Interface re-embedding represents the final stage of the transformation process through which these digitalized symbols are made available for user interaction via customization, storytelling, and simulation.
3) Core-periphery structure. The symbol domain presents the structural characteristics of cultural core and periphery. The cultural core is usually stable and normative, representing mainstream values and symbol systems; the periphery is more open and is an active area for innovation and the entry of external symbols (Jia and Wang 2022). Shaanxi cinema once held a central position in regional culture,

but it has gradually become marginalized in the modern communication environment. With the rise of digital platforms, its cultural identity has the opportunity to return to the center from the margins. Young audiences participate in cinema through short videos, virtual performances, interactive applications, etc., gradually integrating it into the contemporary mainstream digital cultural space, forming a dynamic shift from marginal to central. This process not only reveals the regeneration mechanism of intangible cultural heritage under digital conditions, but it also confirms the high degree of consistency with recent research emphasis that traditional art frequently returns from the margins to the center in the digital context (Moumoutzis et al. 2022).

4) Application cases and academic expansion. At the practical level, the three basic mechanisms of symbolic domain theory have been tested in a variety of cultural digitalization scenarios. For example, the digital game "Black Myth: Wukong" takes "Journey to the West" as its narrative foundation, incorporates traditional aspects like shadow puppetry, paper cutting, and local opera, and re-encodes them using a virtual engine. The present work demonstrates how digital medium can be used to reproduce and spread traditional symbols between cultural groups and the role of translating a boundary and re-encoding as a cross-cultural communication tool. This cross-media cultural practise has demonstrated that the mechanism of the symbol domain is not merely a method of explaining the transmission logic of traditional art in both local and global contexts, but also the origin of methodological research in investigating alternative digitization techniques on different cultural heritage. In the meantime, the academic community is also constantly extending the scope of applications of the theory of symbol domain.

According to Hartley, Ibrus and Ojamaa, contemporary digital platforms have become locations where different sub-symbolic domains engage and where different media and manipulations of symbolism are continually debated, clashing, and renegotiating (Kim et al. 2019). Digitisation of what has traditionally thought of as intangible cultural heritage in this sense is not merely a preservation activity of culture, but an act of active extension of cultural frontiers, a reversal of centre-periphery relationships. On the whole, the symbolic domain theory and the three-level mechanical system of symbolic boundary-recoding-centre/periphery serve to satisfy the methodical approach to the study of protection and sharing of non-material cultural heritage on the digital scene. It, on the one hand, reveals the negotiating of symbolic borders within the traditional culture in the presence of new media; conversely, it clarifies the role of recoding and centre-periphery transformation in regenerating traditional symbols in new locus. This theory not only offers the legal support of the digital preservation of Shaanxi Film Studio, but also provides a significant theoretical framework underpinning the construction of a digital heritage system employed in the future of cultural products. The previous studies (e.g., Xiong and Zhao 2020; Li 2022) have explored digital approaches to shadow puppetry and other forms of intangible cultural heritage using VR, AR, and virtual simulation technologies, most of these works primarily focus on digital preservation or visualization. They lack a structured theoretical mechanism that explains how cultural symbols are transformed into interactive digital systems through processes such as boundary translation, re-coding, and

user-driven engagement. This study addresses this gap by integrating Semiosphere theory with a Digital Living Inheritance framework to explain not only preservation but also the dynamic re-creation and participatory transformation of cultural heritage in digital environments (Table 1).

Methodology

This study aims to examine an intangible cultural heritage conservation framework for Shaanxi shadow puppetry, targeting a younger audience, through digital media technology. Therefore, the study will primarily rely on semiosphere theory, combined with qualitative research methods, including interviews and observations, to construct a digital, living cultural heritage protection. Therefore, this study will primarily rely on semiotic circle theory, paired with qualitative research methodologies such as interviews and observations, to develop a digital and lively framework for cultural heritage protection. The framework is based on an evaluation of modern youth media consumption, digital legacy practices, and literature pertaining to the spread of shadow puppetry, will be followed during the interviews (Braun & Clarke, 2006). This study adopts a social network analytics approach to examine digital influence and structural relationships within online platforms. Data is collected from social media interactions such as likes, shares, comments, and user connectivity patterns. Network metrics like centrality, density, and community detection are applied to identify influential users and structural roles. The results are used to evaluate how these network properties support and improve advertising management strategies.

Participant Selection and Sampling

This study selected Shaanxi shadow puppetry as the research subject. Through semi-structured interviews, 37 respondents, including 30 art students (A1-A30), 3 shadow puppetry scholars (B1-B3), and 4 shadow puppetry artists (C1-C4), were interviewed to understand their perception of Shaanxi shadow puppetry, their cultural identity, and their needs and expectations for digital preservation and dissemination (as shown in Table 2). This study adopts a purposive sampling strategy, where participants were selected based on predefined criteria relevant to the research objectives. The selection focused on individuals who possess direct experience or knowledge of Shaanxi shadow puppetry, including art students with exposure to cultural studies, scholars specializing in intangible cultural heritage, and practicing shadow puppeteers. This approach ensures that the data collected is rich, relevant, and aligned with the study's

Table 1 Comparative Analysis of Existing Studies and the Proposed Digital Living Inheritance Framework

Study	Focus	Method	Limitation
Xiong and Zhao (2020)	Virtual simulation of shadow puppetry	VR-based visualization	Lacks interaction model
Li (2022)	Digital museum system	3D digital archive	No user participation
This study	Digital living inheritance framework	Semiosphere model	youth engagement

Table 2 Structure of respondent data. Created by authors

Sample category	Sample quantity	Gender	Number	Objectives
University Students (A)	30	M	14	Students' knowledge and expectations about shadow puppetry
		F	16	
Scholars (B)	3	M	2	The frontiers study of traditional shadow puppetry and digital shadow puppetry
		F	1	
Shadow Puppetry Artists (C)	4	M	3	The attitude of the shadow puppet industry
		F	1	
Total	37			

aim of exploring digital preservation and youth engagement. Purposive sampling enhances the validity of the findings by ensuring that only information-rich participants are included in the analysis.

A purposive sampling method was used in this research to guarantee that a variety of stakeholders represented. This consists of students, scholars and shadow puppetry practitioners who are representative of the multiple roles in the digital cultural heritage ecosystem including those who consume content, interpret knowledge and practice culture. The level of diversity among participants' backgrounds and experiences gives a balanced perspective on both traditional practice and digital transformation, thus enhancing the validity and comprehensiveness of the research findings.

Based on this interview data, the study will further analyze how the cultural symbols of traditional shadow puppetry are re-encoded in the digital environment, enabling traditional shadow puppetry to achieve cultural re-encoding within the digital context, thereby achieving sustainable cultural inheritance. The semi-structured interview protocol was designed to align with the theoretical framework of Semiosphere, particularly the concepts of symbolic boundary, re-coding, and core–periphery dynamics. The interview questions were structured to capture participants' perceptions of traditional cultural elements, their transformation within digital environments, and their engagement with digital media platforms. This alignment collected data directly corresponded to the intended analytical outcomes, enabling systematic coding and interpretation of themes related to cultural transformation, digital interaction, and youth engagement.

The ethical concerns taken into strict consideration during the process of research. All the subjects were properly briefed on the aims and objectives of the study before collecting the data. Prior consent was duly taken from all the participants through either written or verbal means. It was made clear to all the participants that they could leave the study whenever they wished to do so without any kind of penalties. In order to maintain their confidentiality, no personal information was disclosed, and the data was coded (A1–A30, B1–B3, C1–C4).

Thematic Analysis

The interview data were analyzed using thematic analysis, a method chosen for its flexibility in identifying, analyzing, and reporting patterns (themes) within qualitative data. The analysis process was supported by the qualitative data analysis software NVivo 15. **(**Table 3**).** The framework beyond conceptual design, a prototype was implemented using Unity3D and Blender that algorithmically translates the Huaxian "pushing the shadow" knife-carving technique into parametric 3D modeling rules. This prototype enables the generation of puppet silhouettes with customizable motifs and interactive features. By embedding the procedural carving logic into a digital pipeline, the framework moves from abstract theorization to a tangible algorithmic approach, illustrating how traditional craftsmanship can be systematically encoded and reproduced within digital puppetry environments.

The accuracy and consistency of the coding process, measures of validation were included during the application of NVivo 15 software. A portion of the interview transcriptions was recoded in order to examine the level of consistency within the coding process. The results of coding were later analyzed and compared in order to detect any inconsistencies, which were then resolved by refining the coding process.

The thematic analysis was conducted through a systematic three-stage coding process following established qualitative analysis procedures. In the initial open coding phase, interview transcripts were carefully examined and segmented into meaningful units, which were assigned descriptive labels to capture key ideas. Subsequently, axial coding was performed to identify relationships among these initial codes, allowing similar concepts to be grouped into broader analytical categories. In the final selective coding phase, these categories were further refined and integrated to develop coherent and conceptually grounded themes aligned with the research objectives. Throughout this iterative process, constant comparison and validation were applied to ensure the reliability, consistency, and analytical rigor of the derived themes. In the opening coding phase, the interview data underwent preliminary classification and coding to identify significant research themes, such as "audience cultural identity," "application of digital technology," and "interactive methods of audience participation. "In the axial coding phase, it will focus on analyzing the relationships between these themes, further revealing how digital technology facilitates the recoding of Shaanxi shadow puppetry symbols among different cultural participants. In the selective coding phase, the research will, through inductive analysis, establish the specific components of a digital preservation framework to promote strategies for the inheritance of Shaanxi shadow puppetry. Operation of Semiosphere theory is structured through two key mechanisms symbolic boundary and re-coding which are identified and systematically translated into observable qualitative indicators during the thematic analysis. Symbolic boundary was evident through the participant's reference to tensions between traditional forms of authenticity versus modern forms of digital adaptation and re-coding was evident through the participant's references to the transformation of visual styles, storytelling format and performance practice to digital media. All indicators were systematically coded and mapped to their corresponding themes to create a clear connection between theoretical constructs and empirical data for both mechanisms.

Table 3 Coding Statistics for Shaanxi Shadow Puppetry Interviews. Created by authors

Selective Coding	Axial Coding	Opening Coding (Partial Example)
Interactive experience and young audiences	Aesthetics and Reactions of Young Audiences Curricular promotion and cultural enlightenment Interest stimulation and childhood enlightenment Mentorship and intergenerational transmission Learning motivation and life's demands	A1: If there were software that allowed me to design characters and storylines myself, I would be very interested and willing to share it with friends. A2: If it's in animated form, the kids will definitely want to watch it. It's best to use a more interesting plot, not something too dull. A8: I often see Peking opera and Terracotta Warriors in these videos showcasing intangible cultural heritage. Shadow puppetry can be promoted in the same way. C2: When I was a child, I learned shadow puppetry from my father, who also learned it from my grandfather. So, the three generations of us have made a living by mastering the art of shadow puppetry.
Visual Aesthetics and Cultural Representation	The Aesthetic and Artistic Language of Shadow Puppet Design Shadow puppet character design and modeling language Aesthetic of color and decorative style The fusion of traditional and modern stories The integration of intangible cultural heritage and anime for collaborative dissemination	A4: I will design the characters to be a bit cuter, and I will exaggerate their expressions and reactions to make them look happier. A13: The 'Tian Guan Ci Fu' animation features intangible cultural heritage at the end of each episode. One time, it was about shadow puppetry, and that's how I learned about it. I think the performance is very traditional and quite unique. A20: I've watched 'Journey to the West', 'Investiture of the Gods', and some stories about Judge Bao, and I feel they are even better than animations. The characters are depicted in profile, very much like the composition of ancient murals, giving a sense of historical weight.
Construction of a Digital Protection Framework	Digital preservation and system construction Technological innovation and future expansion directions Construction of a 3D modeling database Online exhibition hall and database Virtual exhibitions enhance understanding.	A1: I've seen virtual tomb exhibitions; the structure and murals are clearly visible. This method could also be used for filmmaking or other intangible cultural heritage arts. A19: I hope that 3D scanning can preserve the image of filmmaking and record performances for future reference. If schools could offer filmmaking courses, or if there were systematic online teaching platforms, it would be more conducive to its preservation. B1: I follow many Douyin accounts that talk about traditional crafts like papermaking, filmmaking, and silverwork.
Negotiating Meaning in the Crisis of Heritage	Immersive technology experience and sense of presence Interaction mechanisms and audience participation methods Young audiences' interests and behavioral preferences VR/AR immersive experiences Interactive games and digital platform dissemination Animation and fun appeal	A8: I hope to see a complete film performance through VR, and even go behind the scenes to see how it's operated. An interactive app could be developed, allowing everyone to control characters and act out the story. It could also be used for promotion on Douyin and Xiaohongshu. A10: "I prefer watching live performances, but I also think technology can help more people understand film". A26: If film can be made into a VR experience, I'm willing to try it. I often see intangible cultural heritage content like Peking Opera and the Terracotta Army in videos; film can be promoted in this way too.

Findings

Through systematic coding of interview data, this article extracts four key factors influencing the digital preservation of Shaanxi Shadow puppetry: first, interactive experience and youth audience participation; second, visual aesthetics and cultural representation; third, the systematic integration of digital preservation pathways; and fourth, the mechanism for meaningful negotiation in the face of a crisis of cultural heritage. There is a high frequency of co-occurrence between "interactive experience" and "visual aesthetics," reflecting that respondents often combine visual perception with participation mechanisms in their expression; "digital preservation pathways," as a structural support, are connected to the other three themes, demonstrating its systematic integration effect; and "meaningful negotiation" is more closely related to "interactive experience," indicating that cultural identity is mainly developed through digital interaction. The level of analytical rigor is enhanced by examining the results through the theoretical framework rather than presenting them solely as a narrative description. The themes that emerge during analysis of the qualitative data obtained during interviews are studied for patterns of interrelation between cultural involvement, digital mediation, and symbolic transformation. Specifically, the themes include such factors as interactivity, visual transformation, digital archiving techniques, and generational transmission. The process of analysis is conducted based on Semiosphere theory and involves examining the symbolic boundaries of cultural heritage in terms of their renegotiation and re-coding.

Interactive experience and young audience engagement

The engagement among young people in a systematic manner, this study proposes an analytical framework that considers four crucial aspects, namely cognitive engagement, emotional engagement, behavioral engagement, and creative participation. Cognitive engagement pertains to the knowledge of shadow puppetry by the respondents through digital media, while emotional engagement relates to their interest and emotional responses. Behavioral engagement is concerned with actual engagement with digital media, including virtual reality, animation, and social media, whereas creative participation entails active involvement through content creation, personalization, and reinterpretation of cultural elements. One of the main issues that emerged from China was the success of the interactive industry, and the success of the year's reception was very important. Due to the lack of universal recognition, the content of the numbers consumed in the moving area is limited to other people's interests. There are many participants, many of them are students (A group), and there are many people who want to participate and have a joint creative opportunity. The first-place student's comments, personalization, physical ability, leadership and encouragement: "How do I know what I can do to understand the current situation, how I feel about it, and what I want to do with my friends?'' (A1).

The attractive force of the masterful number format (as you play) is also the type of system that can be used to create a player who can play the game in a yearly manner, and can also be combined with a combination of colour and strategic elements" (A12). In addition, the immersion type technology has also been developed and

proven to be a powerful tool with deep reciprocity. Participant design, virtual reality (VR) or augmented reality (AR) can be used as a visual representation, and can be used in a completely different terrestrial presentation format. 1st place system (C group) presentation of the general, viewing and viewing of the post-shogunate, combined use of the control system: "I hope that the VR viewing will be completed, and it will be perfect." I understand the production process after entering the program, and the process for mutual operation can be changed by each individual. Scholars (B group) also have the ability to develop new technology, among which the first scholar displays: "As you can see in the VR format, I want to try it" (B4).

Visual aesthetics and cultural representation

The second overall issue proved to be the ambiguity of the question of beauty and cultural expression within the digital representation of the Shaanxi shadow arts. Both of them were aware that there could be a very fine line between the kind of innovation sufficient to meet the demands of the modern aesthetic and not to lose the feel of genuineness and personal craftsmanship of the traditional culture. No one refuted that modernisation was necessary, the question was which kind of modernisation. A large proportion of the respondents would prefer moderate aesthetic modifications on the digital version, to make it appealing, particularly among the students. Stops were to change the character design so that it would be more suitable to the modern audiences (example: to make sure that the characters liked it; to make certain that they showed a stronger reaction and that their faces and expressions were more exaggerated) (A4). In addition, the experimentation with visual effects was encouraged: a combination of the project elements and the modern tendencies of anime could form a distinct blend, potentially, with a touch of a more colourful palette too (A7). Yet these efforts came into conflict with the sheer conviction of maintaining traditional arts and culture. The findings indicate that digital influence is strongly concentrated among a small group of highly central users who drive most content diffusion. Social structures such as tightly connected communities significantly enhance message spread and audience engagement. Social network analytics reveals clear patterns of influence that can be leveraged for more precise advertising targeting. Overall, integrating network insights into advertising management improves campaign reach, efficiency, and user responsiveness.

There were scholars, artists, even some students who stressed the need to hold onto traditional values of craftsmanship and aesthetics. Specifically, one writer has issued a warning about the risk of losing authenticity in the desire to gain immediate superiority: The innovation should be publicised, but maintaining the core cultural motifs and the traditional crafts should stay the same (B1). We too treasure distinct traditionalising aesthetics; one of our pupils had the clearest idea of the merits of the classical style: (The figures) are in profile, as in the composition of ancient murals, that it creates a feeling of historical earnestness) (A20). The art which had been placed in it has been sketched suggestively by the carver: Sculpturing needs a great deal of forbearance and art… with cowhide…. each work is unique… This means that in a more general sense, a great deal of inference in line with this theme is that the thing of visual adaptation can, and must, be negotiated. This version should be made

in way that it retains the aesthetic and cultural meaning of original piece yet it should include few details that are likely to be of interest to modern audience.

Needs and approaches for digital preservation

The thematic analysis transcended aesthetics and involvement to unveil pragmatic anticipations of how the Shaanxi shadow puppetry can be rescued and handed down online. Those who answered said that the digital tools were highly effective in documenting and displaying and teaching and sharing with community. Sustainability and usability emerged as major qualities raised several times. High-quality recording became significant in preservation. To present 3D scanning as an alternative to save the image of the shadow puppet, one of the researchers elaborated that it would be a nice touch to capture the process of the performance and document the role of technology in restoring the hardcopy and soft copy of this art (B2). The potential of virtual exhibitions to reach more people and expand their knowledge was also acknowledged, and other components of the cultural heritage were compared to the virtual tomb exhibition: This approach can also be valuable to shadow puppetry and other intangible cultural heritages (A18).

Moreover, the participants realised the importance of online environments in solemn learning, as well as in participation by the population as a whole. It required more educational materials and to introduce systematised online instruction or to provide institutional education in schools (B2). Capitalising on the popularity of social media tools in reaching and attracting new audiences, particularly the youths is critical. Respondents also noted active use of relevant content creators-"I follow dozens of Douyin pages with traditional crafts such as papermaking, shadow puppetry, and silverwork" (C1) and went as far as to recommend the use of youth-friendly platforms: You can also promote it on Douyin and Xiaohongshu (C3). Preservation, instruction and interaction were dreamy ideas, also to be implemented by special interactive applications as mentioned in Theme 1 (C3). These recommendations imply that what Shaanxi shadow puppetry requires is not merely the emergence of discrete digital works.

Addressing the transmission crisis and generational negotiation

Another last motif reused was the pressing issue of cultural conservation and the magnitude of the generation gap that Shaanxi shadow puppetry was gripping. In both, participants raised concerns around the sustainability of the art form, indicating that the audience is getting older and that it is challenging to infiltrate younger generation audiences and practitioners. The need to remain relevant within a transforming media environment was all too tangible. In answer to a student who has explained one of the issues associated with capturing the interest of peers: younger people are not interested in traditional arts now, unless they are done in a new way: a short video or an interactive experience (A10). It is stated that another major issue of the old troupes' concerns recruiting youth to replace and train them: It is becoming very difficult to find a younger generation who is going to know them and acquire the art; it is time-consuming and exhausting, it does not fit the contemporary time and place (B3).

It was also concerned that the prevailing, family-based modes of intergenerational transmission faced danger.

One artist wrote of this ancient exchange, so rich in memories: When I was a boy, I was taught shadow puppetry… by my father who had learned it by my grandfather. My family is 3 generations of shadow puppeteers. (C2) This autobiographical account underscores the monumental loss at the onset of this developing family- and community-based learning system when it turns ill. In this context of crisis, digital platforms, including the exciting tactics explored in Themes 1 and 3, are reliably considered to be the most important weapon in the struggle against the generation gap. The respondents think digital media is not simply a means of sustaining the history but a crafty means of conveying a firsthand interest (possibly through the channels of mass media) and possibly catalysing a deeper, more lasting commitment-engagement that is the bedrock of the revival. This is a slightly changed quotation that stresses the idea that the digital preservation project will have to be strategically aimed at active intergenerational communication and knowledge transfer. It should not just conserve but guarantee active involvement and engagement of the younger generation in the traditional culture. Based on the thematic analysis, this study does not only validate existing trends but formulates a transferable methodological framework that links symbolic transformation, digital interaction, and user participation into a structured process applicable to other forms of intangible cultural heritage.

Conclusion

This paper will discuss the problem of conserving Shaanxi shadow puppetry in the digital age. Interpretative interview analysis with students, scholars, and artists will unravel critical issues and opportunities and will be supplemented by an invitation to develop a new paradigm of digital living heritage. The outcomes can be exemplary of massive potential of digital media to impress young girls with their interactivity (Theme 1) and smartly manipulated visuals (Theme 2). It states that action to bridge the intergenerational gap in transmission (Theme 4) and digital preservation strategies (Theme 3) and archival preservation are critical. These are the opportunities and problems that will be pursued by the proposed digital living heritage framework to address so that the young can appreciate and be interested in Shaanxi shadow puppetry better. Future possibilities can perhaps be seen in potential future technological progress in artificial intelligence modelling representation and augmented reality communications as creating additional possibilities in relation to this legacy. While platforms such as Douyin and Xiaohongshu and technologies like VR are widely adopted in China's cultural sector, this study moves beyond tool-level recommendations by identifying how specific interaction conditions influence youth engagement and cultural retention. Thus, the contribution lies not in suggesting technologies, but in structuring their cultural effectiveness within a systematic engagement model.

Interpreting the findings

Such focus on the experiences of interaction (Theme 1) is consistent with the well-known perception of the present youth generation as digital natives who require engaging and co-created experiences when interacting with media. A student confirms this via a remark that he/she explicitly desired a chance to develop his/her characters and storeys (A1) or experience a gamified interaction (A12). The deficiency with regard to passive digital presentation techniques, suggesting a set of prior debates that justified only the digital safeguarding of documental source content, justify the recored shift to interactive presentations, which play a pivotal role in the transfer of living legacy. The work, therefore, empirically proves that interactivity, as in the case of Shaanxi shadow puppetry, is not just acceptable but even perhaps necessary to secure the interest of the younger generation and establish an active relationship. A core conflict of preserving heritage in the age of digitalism is the tension between visual appeal (Theme 2) and cultural representation. Even though, it is clear that participants (i.e.) students were keen to upscale the quality of the works by modernising it say, by adding attractive character designs (A4) and anime influence (A7) it is clear that academics (B1) and student appreciation of historical art (A20) said that excessive modernisation may lead to distortion of the quality and cultural stand of the works.

It is part of the larger discussion of how to preserve the authenticity of intangible cultural heritage and respond to new environments and publics. This optimal ratio is not that simple and may also involve a collaborative design approach when incorporating both the traditional inheritors (i.e., the traditional emphasis on the particular carving tools used in C4) and the intended audience to maintain the cultural spirit without allusions to the modern tendencies in aesthetics. The role of technologies, which can raise attention and awareness, is highlighted through identified digital preservation needs and digital preservation processes (Theme 3). The ideas of the participants, e.g. the introduction of 3D scanning of documentation (B2), the creation of easily accessible online learning websites (A18), or the use of the popularity of a popular social network, e.g. Tik Tok and Red Book, to promote (C1, C3), are so, so far superior to the dead digital archives. These results reinforce the literature that glorifies multimedia, virtual reality, and database technology, but grounds such covertures in the narrower framework of Shaanxi shadow puppetry, and the needs of the future audience to artworks and the needs of the present practitioners to livelier, more open approaches. The study concludes that digital influence plays a crucial role in shaping user behavior within interconnected social networks. Social structures significantly impact how information spreads, making network positioning essential for effective communication. Social network analytics provides valuable insights for identifying influencers and optimizing advertising strategies. Overall, integrating these approaches enhances the efficiency and impact of modern advertising management.

Lastly, the analyses of crisis of transmission and intergenerational negotiation (Theme 4) emphasise the urgency of the problem. The results indicate that digital devices are not merely perceived as preservation aids, but are described as one of the most essential of tools to overcome the generation gap, when artists sharing their

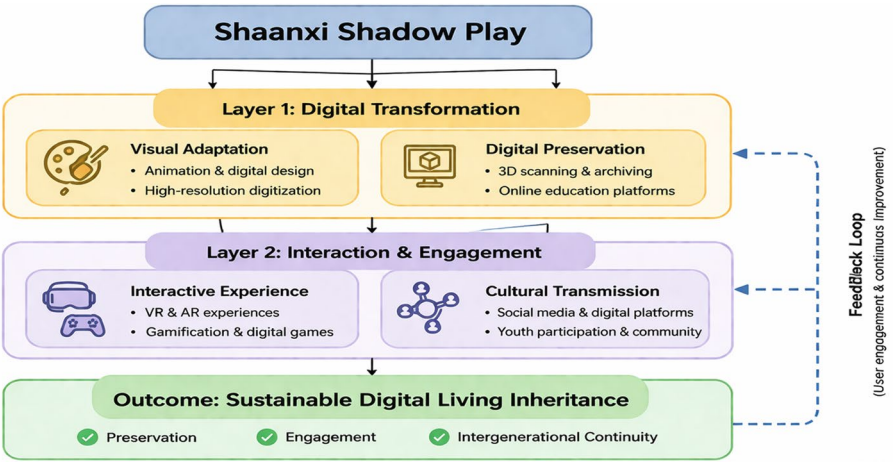

Fig. 1 Architecture of the digital living inheritance framework for shaanxi shadow play

family traditions (C2) and scholars giving comment on the fact that it is so challenging to find successors (B3), can reengineer the knowledge transfer process between generations. This is a first-hand solution to the issue observed in the literature: how to translate the fleeting online fascination (e.g. as perceived in A13, possibly after exposure to shadow puppetry in other media sources) into long-lasting exposure and cultural recognition. Digital platforms create novel modes of teaching and learning and, with proper development, can offer young people new points of interest (and capture their interest), they can offer them new possibilities of cultural renewal (then, answering the demands of A10).

The digital living inheritance framework

The Shaanxi shadow puppetry digital living heritage framework (Fig. 1) is the suggestion of the findings made above. The limitations of generic digital heritage approaches, the framework is extended by incorporating a technique-specific encoding layer tailored to the unique mechanics of Shaanxi shadow puppetry. In particular, traditional craftsmanship such as the "pushing the shadow" carving technique is treated as a critical cultural feature, capturing fine perforation patterns, layered translucency, and knife-based detailing.

In contrast to the general digital heritage model that focuses mainly on the classification of technologies, including VR, AR, social media, and 3D scanning, the Digital Living Inheritance model presented in this study pays special attention to the semiotic negotiation process in terms of those technologies. In the Shaanxi shadow puppetry tradition, semiotic borders are re-shaped based on the dialogue between cultural traditions (such as puppet images, narratives, and performing gestures) and the technical possibilities of digitization. However, the re-shaping of semiotic borders does not occur in the same way for all cultural forms, but rather involves a unique logic of transformation that is characterized by visual silhouette and performative narration.

The Digital Living Inheritance framework is not intended as a descriptive synthesis but as an operational tool that guides the systematic transformation of cultural heritage into interactive digital ecosystems through defined stages, inputs, and outputs. The framework extends beyond strict preservation to dynamic model, which considers active engagement of the audience and cultural revival by the use of digital networks. The thematic analysis conceptual structure is based on the major dimensions of thematic analysis, the major artistic attributes of shadow puppetry, the mediums of digital distribution and interaction, and the means of audience (with particular emphasis on the youth) targeting. Regarding Theme 1 (Interactivity/Youth Engagement): This framework is the interactive digital media, virtual performance simulators, and the programmes that enable people to add characters or storeys. The adoption of immersive technology, specifically VR/AR, in this framework is grounded in interaction and experience-based models. The interaction model encompasses user-controlled navigation, manipulation of characters, and structured storytelling scenarios, enabling users to actively engage in the exploration and recreation of shadow puppet performances. In terms of experience design, key factors such as spatial presence, real-time feedback, and multimodal interaction (visual, auditory, and motion) are incorporated to ensure an authentic and immersive representation of shadow puppet performances. It is a direct response to the urge to do and to feel creative (e.g., A1, A12, C3) in young participants to become more motivated and emotionally engaged in order to get rid of passive viewing. Based on Theme 2 (Aesthetics/Expression): Theme 2 propotes controlled production, yet it also propotes restrained reproduction of the distinctive visual appearance of shadow puppetry on the computer. It looks at how guidelines are established, how we might collaborate with artists (e.g. C4), and designers, to reconcile traditional craftsmanship (as A20 treasured) with the existing aesthetic preferences (as A4, A7 articulated), and how we might elevate the attractiveness of the result without disturbing the cultural authenticity.

Regarding Theme 3 (Digital Requirements/Practises): The 3D scanning process for artifact digitization follows a structured workflow accurate digital reconstruction of shadow puppetry artefacts. The process begins with data acquisition using structured light or photogrammetry-based scanning to capture high-resolution geometric and texture information. This is followed by data processing, including point cloud cleaning, mesh reconstruction, and surface optimization to refine the digital model. Finally, the optimized 3D model is integrated into digital platforms for visualization and interactive use. Key parameters considered in this process include scanning resolution, texture mapping quality, point density, and mesh accuracy, which collectively determine the fidelity of the digital representation. This workflow ensures both visual accuracy and cultural authenticity in the digitization process. The tangible digitization practises suggested by the participants are synthesised within the framework, and a multi-platform ecosystem is envisioned. It may involve high-fidelity digital collections (high-fidelity collections like 3D scanning are suggested in B2), online museums/exhibits that are readily available (A18), online learning materials (B2), and interactive applications or social media spread (C3). Digital technology here refers to a preservation medium and a cultural access, knowing and teaching medium. The conventional digitization techniques are extended in this study through the integration of AI-Generated Content (AIGC) as an integral component of the framework

rather than a supplementary extension. AIGC is positioned as a generative mechanism that enables automated character design, narrative variation, and visual style adaptation based on traditional shadow puppetry elements.On Theme 4 (Inheritance/Intergenerational Negotiation): This framework is interaction and participation-based, and the task is to be capable of opening up new horizons of intergenerational learning and dialogue that would be directly related to the witnessed phenomenon of the inheritance crisis (B3, C2). It promotes the development of traditional preservation paradigms, in which the past-focused preservation is substituted with living inheritance of the present and future. The building can also fit the vehicles and platforms with which the traditional knowledge can be translated and re-created by the young generation that will be able to transform into new forms of apprenticeship and hold of culture the digital natives are so concerned about. The framework can be applied in practice by following a structured sequence: identifying key cultural elements, translating them into digital formats, embedding them within interactive platforms, and enabling user-driven reinterpretation. This transforms the framework into a replicable tool for digital heritage design.

Figure 1 shows an architectural representation of the Digital Living Inheritance model in terms of three layers which include: digital transformation, interaction and engagement, and outcome. In the first layer, the traditional Shaanxi shadow play is transformed by the application of techniques that are digital in nature; these include visual modification and digital preservation, such as animation, scanning, and archiving. User engagement can be fostered in the second layer through the provision of opportunities for interactions such as those created by virtual reality (VR), augmented reality (AR), and social media platforms. Finally, in the third layer, there is the focus on the outcomes where the users' engagement results in digital living inheritance.

Implications of the study

The contributions of this work are numerous. In theory, it provides an empirically-infused paradigm of living inheritance in the digital realm with a focus on audience-relation, aesthetical bargain, and technologically viable incorporation in the preservation of ICH like Shaanxi shadow puppetry. The findings and the proposed structure offer practical advice to cultural institutions, teachers, artists, and technology creators who want to remodel ancient arts to the younger generation. It is user-centred and concentrates on the needs and preferences determined by the direct contact with stakeholders. The Shaanxi shadow puppetry, the proposed framework is methodologically adaptable to other intangible cultural heritage domains such as traditional performance arts, crafts, and oral traditions, where similar processes of symbolic translation and digital engagement are required.

Limitations and future research

The article explores the issue of how to retain Shaanxi opera in a modern environment, offering an analytic map of the digital living heritage in the digital space. This study lays bare this recoding of cultural symbols in the new media setting and struc-

tural place of youth in the construction of cultural identity by the systematic encoding and thematic industrialization of the interview data based on theory of symbolic domains. Through this frame, it is clear that digital preservation is not viewed as a readily mechanical practise of archiving, but as a multi-dimensional practise, that involves symbolic translation, media reconstruction, and audience involvement. The inclusion of the AIGC creative platforms, virtual reality exhibition locations, and designing digital characters allows the study to broaden the expressive modes of opera dissemination into practise in the future. To illustrate this, the example of generative technology-based character generation systems combined with short video editing tools could encourage re-creation and secondary distribution, lower the barriers to youth participation, and ensure that the traditional opera is more visible and participatory within the digital cultural landscape. This study is subject to several limitations. First, the cultural specificity of the research context may influence the interpretation of the findings, as the analysis is confined to Shaanxi shadow puppetry. This focus may limit the generalizability of the proposed framework to other forms of intangible cultural heritage, which may involve different symbolic systems, transmission practices, and socio-cultural dynamics. Second, technological accessibility may affect the feasibility of proposed digital solutions, as not all regions or institutions possess equal access to advanced tools such as VR, 3D scanning, or interactive platforms. Third, environmental and infrastructural factors, including institutional support and digital literacy levels among participants, may further influence the implementation of digital preservation strategies. These contextual factors should be considered when interpreting the generalisability of the results.

Author contributions Ying Zhou: Conceptualization, Literature Review, Methodology, Data Collection, Conducting Interviews, Data Curation, Thematic Analysis using NVivo, Writing – Original Draft Preparation, Visualization.Sze Joon Jong: Supervision, Research Design Guidance, Methodology Review, Validation, Critical Review & Editing, Project Administration, Final Manuscript Approval, Corresponding Author.

Funding No funding is available for doing this research work. The authors declare that they have no conflict of interest. The authors declare that no potential conflicts of interest (financial or non-financial).

Data availability This manuscript has no associated data.

Declarations

Competing interests The authors declare no competing interests.

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Ethical approval This article does not contain any studies involving human participants or animals performed by any of the authors.

Consent to participate Not applicable.

Consent for publication All authors have provided consent for publication of this manuscript.

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