P/REFERENCES OF DESIGN

THE EFFECTS OF THE SOUND NARRATIVE OF AN ARTISTIC INSTALLATION ON CULTURAL HERITAGE LEARNING.

Jiaxin Chen[a], Baosheng Wang*[a]

a Hunan University, School of Design, China
* walterwang840217@gmail.com

DOI: 10.63442/DUUO2476

KEYWORDS | SOUND NARRATION, ART INSTALLATION, CULTURAL HERITAGE LEARNING

ABSTRACT | In the realm of digital cultural communication within cultural tourism, visual experiences have traditionally held dominance. However, visual information overload can lead to issues including dispersion of user attention, comprehension difficulties, and constrained imagination. Sound possesses the capacity to enhance attention, cultivate an atmosphere, stimulate the imagination, facilitate deep thinking, and establish intimacy. Despite the potential of sound for cultural heritage communication, research on the impact of sound narration in cultural heritage learning is currently limited. Although some studies have confirmed that sound can enhance the learning experience of visitors at cultural sites, a comprehensive theoretical framework to encapsulate these effects has not yet been established. This study aims to investigate the effects of sound narration on cultural heritage learners through the design of a sound interactive installation based on the Changsha Kiln ceramics. Our aim is to systematically compile these impacts into a theoretical framework. The experiment utilized reflective sessions and observations as the primary data collection methods, based on text and interview data, primarily employing grounded theory for qualitative analysis and supplemented by bloom for quantitative research. Through a three-level coding process, the interview data were categorized into concepts and categories, leading to the proposal of a theoretical framework. The pilot results revealed that, regardless of qualitative or quantitative analysis, sound narration has a positive impact on learners of cultural heritage. We ultimately summarized the effects of sound narration on cultural heritage learners into a theoretical framework, encompassing perceptual, affective, conceptual, connecting, and strategic aspects.

1. Introduction

1.1 Current Research Status of Cultural Heritage Communication

Cultural heritage-themed exhibitions are essential in showcasing local culture, preserving collective memories, and integrating cultural experiences with tourism opportunities. With the advancement of digital technology and the rise of new media art, a growing number of exhibitions have begun to incorporate gaming elements, interactive installations, and immersive experiences. This fusion introduces innovative and interactive methods for experiencing cultural heritage. These innovative exhibition methods primarily utilize visual experiences for dissemination, such as *Virtual Reality* and *Augmented Reality* applications, developed and popularized within cultural heritage sites due to their entertainment and educational potential. Museums, serving as the main venues for cultural heritage exhibitions, create a visually demanding environment, where multiple exhibits, objects and displays compete for visual attention (Bitgood 2013). Visitors' visual attention is characterized by its fleeting and variable nature. The overload of visual information can result in distractions within user attention. Research indicates that sighted visitors often only glance briefly at individual exhibits or artworks, with the average dwell time being less than half a minute (Smith 2017). The majority of a user's gaze is directed towards the visual features and layout of the exhibit, whereas less consideration and understanding are given to deeper aspects such as the function and history of the exhibits. Visual elements inherently provide an intuitive representation, allowing users to grasp pictorial information through their visual senses without the need for imagination, thereby achieving the goal of understanding images. This characteristic partially impedes users' ability to reconstruct or creatively reinterpret images, curtailing their imaginative capacity. Anabela (2021) suggests that incorporating a multi-sensory experience, including the auditory, olfactory, tactile, and gustatory senses, in cultural heritage communication could inspire fresh perspectives and ideas, thereby leading to increased curiosity, exploration, and discovery among users. Despite the increasing trend towards multi-sensory experiences in museums, auditory remains overlooked. Less attention, less investment and very few infrastructures, human professional resources and less time are devoted to sound simulation, sound composition and sound design accompanying the visual narration in the field of cultural heritage and education. Underlying this refusal of museums is a somewhat unconscious distrust of sound, seen as a disturbing, uncontrollable, and unstable nuisance within the silent and reverential museum space, which was created for and by the objectifying gaze, particularly along visitor routes and in front of exhibits, where silence typically prevails. If present, museum staff tend to keep the volume so low as to be almost imperceptible. Considering the restrictions on museum visitation, sound can be delivered unidirectionally or multi-directionally through headphones in the context of cultural tourism or museum experience design.

1.2 The Advantages of Sound in Cultural Heritage Communication

Sound possesses significant and unique communicative abilities, and the experiential design of contemporary museums presents considerable potential for integrating sound. This article compiles the relevant advantages of sound in the dissemination of cultural heritage. (1) Sound can enhance user attention. Williams (2023) suggests that the delayed unveiling of an unseen sound source elicits suspense and tension, prompting users to focus on the exploration of reasoning and the construction of the full content of events. Although users have agency over visual imagery, allowing selective filtering of undesired content, the continuity of sound means users must passively accept all sounds, thus ensuring prolonged attention. (2) Sound can render atmosphere and evoke emotions. Cortez (2020) observes that sound is capable of creating specific atmospheres through soundscapes to evoke certain emotions and highlight thematic ambiance. Bertens (2019) has demonstrated that the use of sound in museums is able to stimulate visitors' emotional engagement. (3) Sound has the potential to stimulate users' imagination. Sighted participants viewed a series of photographs from *the Museum of London*'s collections presented in a digital format, and a comparison was made between the use of an audio descriptive guide (AGD), a traditional audio guide and visual exploration alone (Hutchinson and Eardley 2021). The study found that participants

who listened to an ADG when viewing photos demonstrated richer memories of the artworks. They not only recalled more visual details such as the content elements of the photos and their spatial arrangement, but also recorded more thoughts and emotional reactions to the artworks. (4) Sound possesses the capacity to stimulate profound reflective engagement among users. For instance, an ancient bridal headpiece designed with enlarged, spiky hair accessories, which a visitor would be invited to touch, manipulate, and wear. Embedded microphones within the headpiece emit a loud, piercing noise, prompting reflection among visitors. Ingold (2000) suggests that the purpose of the emergence of soundscape is not to represent, but to reveal, to penetrate beneath the surface of things in order to reach deeper levels of knowledge and understanding. (5) Sound can foster a sense of intimacy. Due to its directional nature, sound requires visitors to approach closely to the source. For example, Brackenbury (2023) crafted ceramic tiles into sound devices within a museum setting. When visitors pass through illuminated areas, directional speakers activate, and the tiles emit sounds narrating the stories of female artisans working in prisons. This proximity to the sound-emitting tiles subtly cultivates a sense of intimacy.

1.3 The Study of Existing Sounds in Cultural Heritage Education

Only recently have the acoustic properties of museum spaces or the acoustic horizons created by audio guides been discussed. A more comprehensive approach to the multifarious presence of sound in museums was published in 2019, in a special issue of curator: *The Museum Journal*, co-edited by Eric de visscher and Kathleen wiens. Turning to the application of sound in cultural heritage, the *The Sounding Object* project, a collaboration between the *Royal College of Art* (RCA) and *VARI*, showcased the immersive power of sound in cultural heritage. The project used sound design to critically engage with the museum's historical narratives. Additionally, Caroline devine's *Resonant Bodies* (2018) brings the sounds of a number of Indian classical instruments to life on the glass of their display case. The work was diffused using resonators attached to the case that made the glass surface vibrate with recordings of the sounds of the instruments—effectively acting as a giant speaker and allowing the instruments within the case to “Speak” to a visitor. This innovative use of sound not only enhanced visitor engagement but also fostered new connections with the audience. This research (Cortez 2022) resulted in the identification of five sound-based multi-modal museum practices, namely, 1. Sound as a mode for lecturing, 2. Sound as an artifact, 3. Sound as "Ambiance" or soundtrack, 4. Sound as art, 5. Sound as a mode for crowd-curation.

Despite the wealth of cases and innovative perspectives offered by existing research, research into the role of sound in cultural heritage learning is still limited, with an even smaller number of studies addressing the impact of sound narratives on the learning of cultural heritage. Hence, we are initiating a pilot exploration to examine the effects of sound narratives on cultural heritage learning, with the goal of developing a theoretical framework that encapsulates these impacts. This pilot exploration aims to offer insights and guidance for scholars and practitioners in the relevant fields.

2. Related Work

2.1 Sound and Narration

Sound possesses a unique narrative function, serving to represent and narrate aspects of artistic conception, characters, and plots. Language, sound effects, and music constitute the three core elements of sound narration. For instance, in the sound narrative of *A Man Escaped*, language not only conveys explicit semantics but also intricately links storylines and vividly depicts character images. Sound effects extend the visual space, represent character psychology, and enhance environmental realism. Music propels plot development, communicates character emotions, and acts as a metaphor. Gopalan (2017) emphasizes that employing rich layers of ambient sound in narrative strategies can create an immersive sense of realism. For instance, In *The National Treasure*, the artifacts' southward migration is compellingly narrated using multi-layered ambient sounds—bombings, car crashes, fires—thereby enriching the introduction of the *Stone Drum* in the museum's collection. The advancement of sound narration necessitates an understanding of

specific cultural backgrounds, thus unavoidably embodying national cultures. For example, *Night Banquet in Tang Dynasty* merges virtual scenes with real stages through *5G+AR* digital technology, where sound narration carries the national spirit and culture, eliciting a sense of national emotional resonance among the audience, strengthening cultural identity, and thereby facilitating cultural dissemination and enhancing cultural confidence.

2.2 Sound Narration in Cultural Heritage

In recent years, numerous curators have shifted their focus towards the development of multi-sensory exhibitions, with a particular emphasis on auditory experiences. For instance, the sonic cultural artifact, *Diabolo*, is depicted in the *Beijing local chronicles* as producing sounds that are “As resonant as a bell and as delicate as the flutter of an insect's wings”. The sonic heritage encompasses a variety of traditions, significant sounds, music, individual instrumental or vocal techniques, and soundscapes. However, current exhibitions primarily focuses on the display of tangible objects and images, overlooking the perception of sound within cultural heritage. This neglect of sound representation can lead to a gradual erosion of sound folklore. In the realm of cultural heritage and the dissemination of sound, sound categorization encompasses multi-character sounds, cultural heritage sounds, and environmental ambiance sounds. For instance, the sound narrative in *China in Classics* employs a multi-layered sound source including vocal language, background music, and acoustic scenes. This enriched sound quality enhances the listener's imaginative space and conveys deeper connotations. Michalis (2023) has designed a context-aware audio guides tailored to the actions and interests of museum visitors. These systems make use of wearable cameras and advanced machine vision algorithms, enabling real-time recognition of scenes and inference of context. In the realm of *Audio Augmented Reality* (AAR) applications, the exhibits themselves become narrators, emitting sounds or telling stories in the first person. This approach not only reveals "Hidden" sounds within the environment but also significantly enriches the visiting experience. Moreover, it affords users the opportunity to physically interact with the exhibits. Despite considerable expectations, the application of sound narration in the preservation and interpretation of cultural heritage is still limited, with a lack of comprehensive research into its effects on learners of cultural heritage.

In this study, we will systematically review and analyze the latest research on sound narration and installation design. The purpose of this pilot study is to explore the potential positive impacts of sound narration in art installations on learners of cultural heritage. We aims to summarize the theoretical framework regarding the effects of sound narration on cultural heritage learners and provide an initial theoretical basis and reference recommendations for other researchers involved in the design of cultural heritage-related learning.

3. Research Methods

3.1 Designing a Ceramic Art Installation

This pilot exploration is based on the design of a series of sound interactive installations centered around the ceramic culture of Changsha Kiln in china. It aims to study the process of visiting and learning experiences of cultural heritage learners within exhibition halls. Art installations refer to conceptual frameworks or digital environments created by artists (Giulio 2016), which invite participants to explore and experience. Through interaction, participants are encouraged to discover, interpret, and reflect on the meanings of the installation and its components, thereby establishing a connection with the installation throughout the experiential process. Changsha Kiln ware was one of the primary commodities along the maritime silk road during *the Tang Dynasty,* embodying a unique style that integrates eastern and western cultures. We have selected iconic items from different stages for abstract design, incorporating metaphorical features such as scratches on the surface to provide users with ample room for imagination. To facilitate a "Dialogue" between visitors and the historical craft behind the culture, we embedded a speaker inside the ceramic items and used the ceramic space as a mini sound field to emit sounds. Please refer to figure 1 for

details. The sound and touch systems were developed using *Arduino* software (a professional programming platform). The four ceramic installations are arranged in chronological order, each representing a different development period. Initially, users are required to touch the sensors located on both sides of the ceramic object simultaneously, triggering brief sound clips of craftsmanship, as if ancient artisans were demonstrating their skills right in front of the users. These four sets of ceramic audio correspond to the manufacturing states of the four objects, as illustrated in figure 1. Subsequently, by touching the sensors on the ceramic objects again, users can listen to sound narratives in which the ceramics "Reveal" their mysterious origins, conveying knowledge about history, culture, and craftsmanship in the first person. We utilize multi-character narratives, cultural craftsmanship sounds, and environmental ambient effects to strengthen the connection between users and historical culture. Tactile feedback upon touching the body or handle of the ceramics enriches users' perception of the ceramics, thereby creating a tangible cultural experience as if users are shaking hands with history through time and space. Meanwhile, visual cues such as background information and introductions are projected onto a sailboat backdrop using a projector, as shown in figure 2. This pilot study aims to explore the influence of sound narrative on cultural heritage learners and to develop a theoretical framework informed by the findings.

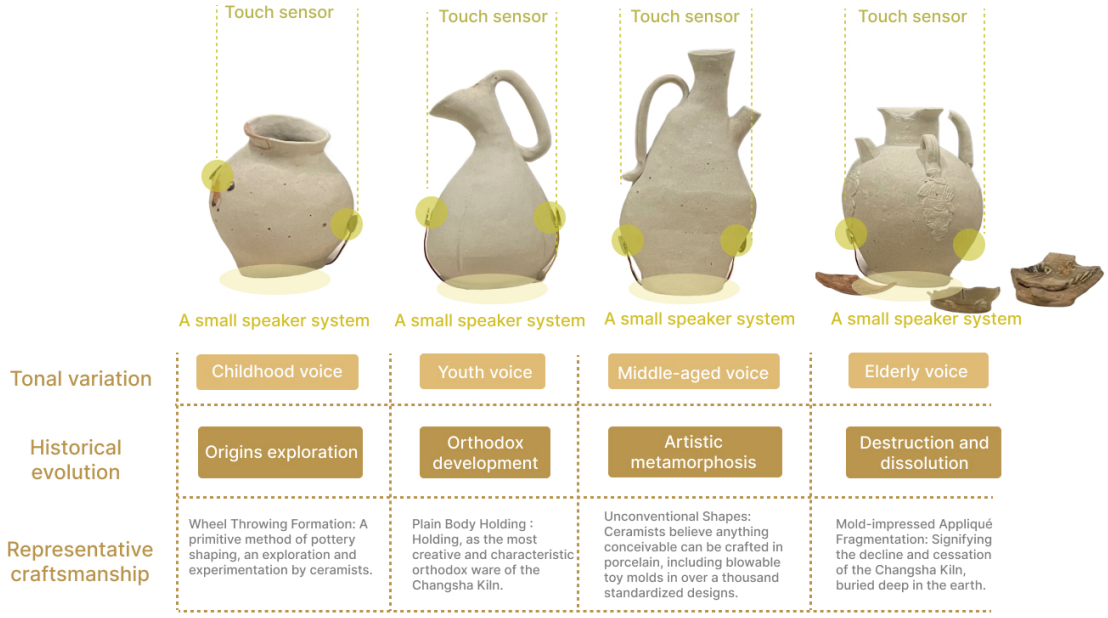

Figure 1. Functional interaction diagram of the art installation.

Figure 2. Experimental setup overview.

3.2 The Experimental Procedure

Our experiment spanned 8 days, encompassing a pre-experiment phase, a formal experiment, and a reflective session. Participants were recruited through advertisements in school general education courses and social groups, ranging in age from 18 to 32 years (median age: 24 years), totaling 68 university students (30 males, 38 females). The experiment was randomly divided into two groups: an experimental group that utilized a sound installation (33 participants) and a control group that engaged with paper materials (35 participants), with each group conducting experiments for an average duration of one hour. The experimental procedure was structured into three modules. In the "Narration about ceramic sounds" module, participants were guided to contemplate the origins of four sounds from the pottery-making process. The "Voices about ceramics" module aimed to assist participants in purposefully seeking answers, revealing how the initial sounds were produced and enhancing their understanding of Changsha Kiln culture through sound narratives. In the "Collaborative narration" module, participants acted as narrators for the Changsha Kiln, working in groups of 2-3 to review and assess the learning outcomes. Images, served as the dependent variable, were displayed via PPT projection. For the control group, the task process remained unchanged, except that all auditory materials were converted into paper materials for reading purposes. The task process for the experimental group is depicted in figure 4.

Figure 3. Experimental group (sound narration) on the left and control group (text reading) on the right.

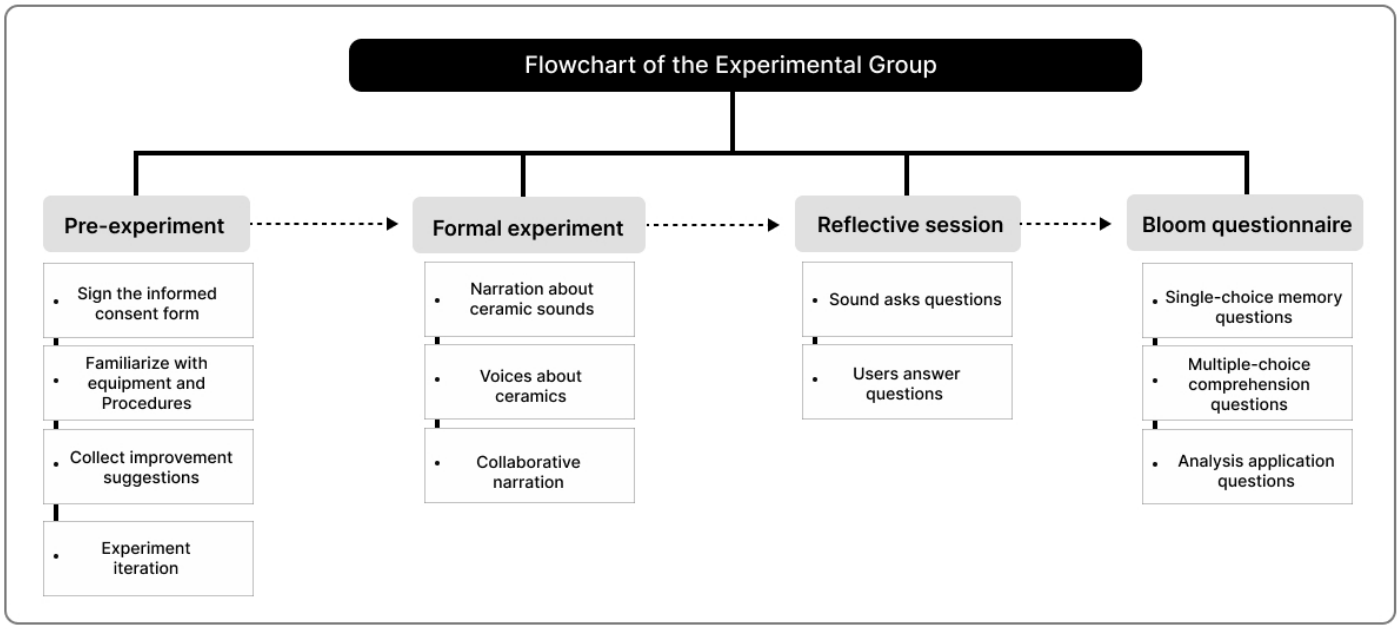

Figure 4. Flowchart depicting the procedure for the experimental group.

Pre-experiment

Initially, participants are provided with a concise overview of the process of this pilot study and invited to sign the paper informed consent form. Researchers offer concise oral instructions to familiarize participants with the equipment. Subsequently, participants engage in the experiment, evaluating the design process and compiling suggestions for enhancements, which leads to iterative modifications of the experiment. Following the pre-experiment phase, participants are required to complete a questionnaire that includes bloom's learning effectiveness assessment and an evaluation of the sound interaction device.

Formal experiment

(1) Stage 1: Narration about ceramic sounds

The sounds encapsulate the quintessential craftsmanship scenes of the Changsha Kiln. At this stage, the installation presents four sets of sound experiences associated with the Changsha Kiln's production process: the kneading of clay, the thudding sound of clay manipulation; the sound of bisque immersion in glaze, the clink of object collisions. The roar of the fiery blaze, the crackle of porcelain fissuring. The shatter of ceramics, the sound of sweeping porcelain shards. The sounds correspond to four states of the objects in the installation. Upon user activation of the sensor, the four sets of sounds are played sequentially. After the sounds end, participants are engaged in a reflective session with structured inquiries such as "What sounds did you hear?" and "What associations did these sounds conjure?"

(2) Stage 2: Voices about ceramics

This study delineates four developmental stages of the Changsha Kiln, each narrated through distinct vocal tones corresponding to different life stages (child, youth, middle-aged, elderly) to represent the kiln's evolution. These vocal tones symbolize the kiln's evolutionary stages. Adhering to Lissa's (2016) recommendation, a first-person narrative approach was employed to enhance emotional engagement and comprehension among the audience, thereby potentially augmenting their learning experience. The sound narration is methodically segmented into three explanatory layers to improve content coherence: (a) Appearance, which includes the form properties of Changsha Kiln artifacts, such as material, decorative patterns, and shapes. (b) Craftsmanship, which includes the techniques and production methods used in the ceramic creation of Changsha Kiln, such as under-glaze painting, applique (applique involves adding low relief clay forms to slurred, scored leather-hard surfaces for embellishment). (c) Culture, which includes the local culture activities related to ceramic production in the Changsha Kiln, such as kiln workers in the *Tang Dynasty* used advertising slogans as characteristic decorations. Complementing the sound narrative, projected visuals and textual descriptions aid users in comprehending the narrative content. The second interaction with the installation's sensor is designed for users to further explore the narrative. For example, initially, users experience the sound of shattering, and in a subsequent round, the sound narrative elucidates the reasons behind the disrupted firing process of the Changsha Kiln. This approach of posing questions and seeking answers through a progressive auditory experience can subtly facilitate users in acquiring knowledge related to the Changsha Kiln. Interview questions include: "Please recall and describe its production" and "What were the most impactful aspects of the sound narrative?"

(3) Stage 3: Collaborative narration

We invite 20 groups of users, each comprising 2-3 individuals, to engage in collaborative narration based on their newly acquired knowledge of Changsha Kiln. Participants are encouraged to adapt, reconstruct, or share the learned content, aiming for a collective narration of a complete story. This method enhances memory retention and clarity for all participants, creating a unified narrative thread and fostering a sense of achievement through team performance. Collaborative narration between two people combines the benefits of cooperative discussion while avoiding the confusion and distractions common in larger groups. It also allows sufficient time for free expression, especially when opinions diverge. Gurtner (2010) notes that individuals differ in their perspectives and focal points in information reception, suggesting that through

mutual complementation, effective cognitive regulation can be achieved, thereby establishing an interdependent learning network.

Reflective session

Participants were invited to partake in semi-structured interviews aimed at delving into their creative conceptualization process and addressing any uncertainties they encountered throughout the process. Reflective interviews encourage users to engage in deeper thought beyond their initial responses that come to mind, for instance, by asking participants to provide reasons or explanations for their actions or occurrences during the interaction. Finally, participants were required to complete a learning assessment questionnaire, devised in accordance with bloom's taxonomy, encompassing single-choice memory items, multiple-choice comprehension items, and analytical application items. Upon the conclusion of the experiment, three experts were invited to evaluate the learning outcomes and related impacts through both qualitative and quantitative methods.

3.3 Experimental Method

In this study, we employed a combination of methods for data collection and analysis. In the pre-experiment phase, semi-structured interviews were primarily used to collect user feedback and opinions, facilitating adjustments to the experimental design while also acquainting users with the experimental process. Upon completion of the experiment, we primarily conducted reflective interviews to collect primary data. This was supplemented by observational methods to document alterations in participants' facial expressions, movements, and behaviors. At the experiment's conclusion, a reflective session was conducted to prompt participants' engagement in reflective thinking and assessment of their learning outcomes.

Our data collection is predominantly achieved through reflective interviews. Posing reflective questions assists users in understanding and articulating their latent needs and goals. Following Atkins (2018) three stages of reflection: noticing, understanding, and planning future actions, we crafted a sequence of sound-based prompts for questioning followed by user responses. By asking "Why" twice, we introduce reflection touch-points, prompting users to take additional time for contemplation and response. Data were collected using a variety of methods, encompassing observation, written and oral responses, surveys, in-depth interviews, stimulus recall exercises, and dialogic interactions.

Our data analysis is based on grounded theory, a qualitative methodology introduced by Glaser and Strauss, is a qualitative method that aims to develop a theory grounded in the data collected. This method emphasizes identifying core concepts within the data, summarizing these, and utilizing coding procedures to construct a theoretical framework. The coding process unfolds in three distinct stages: open coding, axial coding, and selective coding, facilitating a structured analysis. Through the application of *NVIVO* software for analysis, we initially dissected and organized the interview content into over 6,000 original sentences. We extracted high-frequency words, categorizing them into 95 concepts and 27 distinct categories. In the process of axial coding, categories were reclassified based on their logical relationships, leading to the development of primary and secondary categories. Subsequently, during selective coding, all categories were interconnected and integrated, clarifying the relationship between core and main categories through specific cues. The preliminary establishment of a mechanism model for the impact of sound narration on cultural heritage learning. To ensure the objectivity and accuracy of the coding results, we randomly selected 18 participants for interviews as a sample for saturation testing. The coding analysis did not reveal any new concepts or categories, indicating that the conceptual model constructed in this study is theoretically saturated. Ultimately, the effectiveness of user learning was quantitatively assessed using bloom's taxonomy, objectively evaluating different groups of users on their retention of knowledge, comprehension, and application through a written test.

4. Result and Discussion

This study based on textual and interview data, primarily employs grounded theory for qualitative analysis and supplemented it with bloom questionnaire for quantitative research. Through a three-level coding process, the interview data were categorized into concepts and categories, leading to the proposal of a theoretical framework. The pilot results revealed that, regardless of qualitative or quantitative analysis, sound narration has a positive impact on learners of cultural heritage. This framework encompasses five core concepts: perceptual, affective, conceptual, connecting, and strategic, as shown in table 1 and figure 5.

Table 1. Coding analysis of the impact of sound narrative on cultural heritage learners.

Categorization	Categorization	Conceptualization	Connotation
Perceptual	Auditory perception	Sound immersion...	User sound perception and cognition
	Tactile perception	Close-range tactile interaction...	User tactile perception and cognition
	Immersion(objective)	Sense of engagement...	Feeling of immersion during interaction
	Presence(subjective)	Immersed in descriptive setting...	Feeling of being in the described situation
	Curiosity	Reason for curiosity...	Curious or questionable content
	Attention	Point of attraction...	Attention-grabbing aspects
	Memory	Short-term memory...	Users' memory of what they hear
	Quotation	Famous quotes and sayings...	Exact quotation or approximate paraphrase
	Identification	Recognizing sound changes...	Point out things that need attention
	Characteristic	Characteristics of exhibits...	Say the content and other characteristics
	Understand	Deeper understanding...	Understand certain reasons, principles.
	Learning ability	Active learning..	Learning methods, content mastery.
	Retelling ability	Retelling interest...	The ability to retell and express the process
Affective	Emotional understanding	Emotion perception...	understanding of character emotions
	Emotional expression	Confusion; shock...	Emotional expression in face/body posture
	Emotional regulation	Emotional adjustment...	Reframe emotional emotions
Conceptual	Simple reasoning	Inference part connection...	A single analysis or interpretation section
	Complex reasoning	To make assumptions...	Deep inference or system overview
	Ability to predict	Predict the plot...	Predict what's going to happen
	Ability to reflect	Reflect on current cognition...	Reflect on yourself currently or in the past
Connecting	Life-connection	Personal experience connection...	Contact personal life analogy comparison
	Knowledge-connection	Contact history...	Think of existing knowledge
	Inter-exhibit connection	Exhibit contact...	Connect elements between different exhibits
Strategic	Use	How to find the answer...	For device usage procedures
	Sharing	Share understanding;...	Share knowledge,encourage others to participate
	Performance	Body affirmation...	Evaluate performance when working together

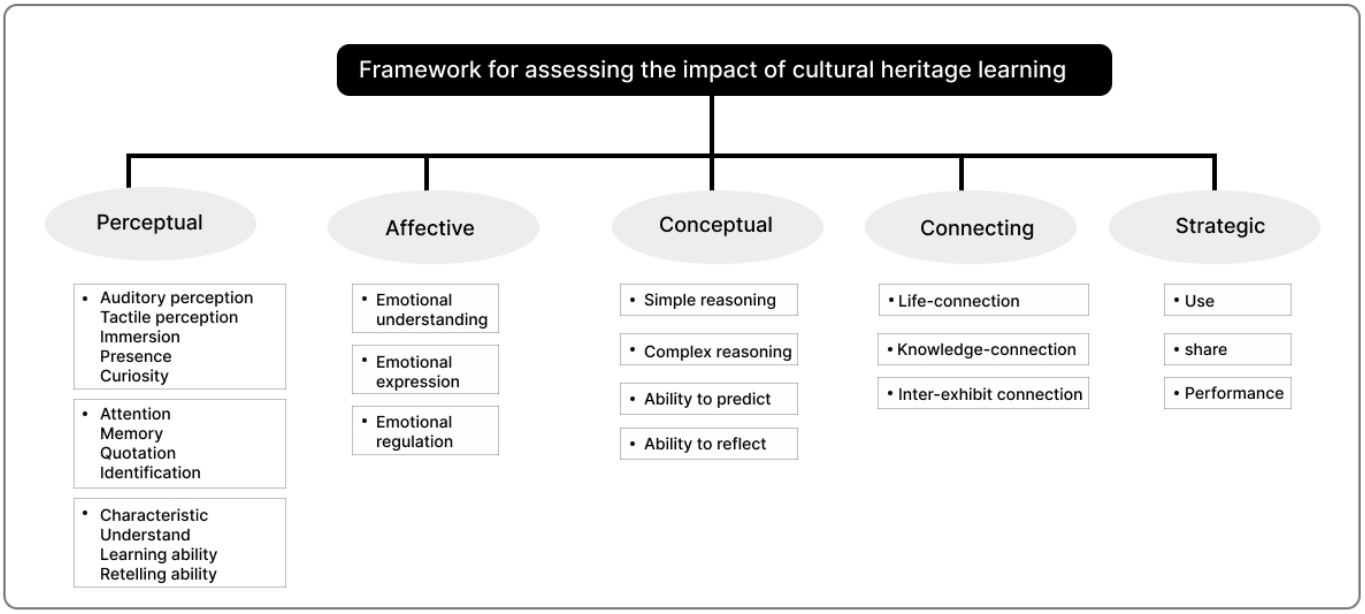

Figure 5. Theoretical framework of the impact of sound narration on cultural heritage learners.

4.1 Perceptual

This category encompasses discussions related to participants identifying elements within their environment. Allen (2002) posits that when users pinpoint and share essential content in complex settings, it denotes learning. This behavior is considered indicative of learning, as it involves recognizing and communicating significant elements in a complex environment. The category is subdivided into areas such as auditory perception, where the user acknowledges the perception and cognition of specific sound content, for example, "The sound conveys a sense of historical ambiance." Tactile perception involves users discussing perception and cognition related to touch, such as "Touching artifacts up close feels as though they are narrating a story." Immersion is experienced when interacting with artifacts, creating a sense of being transported and immersed in the experience, illustrated by "The sound narration engenders a sense of immersion." Presence refers to the user expressing a subjective feeling of being immersed in the described setting, stating, "It feels as if I have truly entered a war-torn era, embodying a pottery jar and sensing the urgency of their escape." Curiosity is manifested when the user expresses curiosity or doubt, with questions like "Why did it break? was it because of a tradition? I have heard about the tradition of breaking pottery before." Attention is drawn to elements that capture attention during interactive experiences, for instance, "This tone is very pleasing", "I would love to keep listening." Memory involves the user's recollection of the content, with comments such as "I remembered all the key details very clearly." Quotation includes accurate quoting or close paraphrasing during the user experience, as in "During the prosperous cultural period of the Tang Dynasty, emissaries from eight nations paid tribute." Identification occurs when the user highlights something noteworthy, for example, "The deep and resonant sound also symbolizes power and authority." Characteristic involves the user describing features of the exhibit, sound, narrative content, saying, "The sound also represents the growth of history, making it clearer and more enjoyable to listen to." Understanding is the user grasping certain reasons or principles, mentioned as, "It is easy to understand." Learning ability refers to the user learning through interaction and gaining insight into the learning process, as in "It naturally expands my knowledge." Finally, retelling ability is the user's performance in recounting, for example, "There is a master craftsman named Wang Er who has purchased a kiln factory..."

What sound narration enhances is auditory perception, tactile perception, immersion, and presence experience. Abundant sound variations and interesting narrative content attract participants. They describe it as "Immersing oneself in the experience of listening to stories." Coffey (2023) indicates that the immersion process can maintain learners' interest and motivation, leading to increased engagement, better understanding of the learning material, greater persistence, and increased resistance to potential obstacles. It was found that the participants in the experimental group exhibited stronger attention and curiosity

compared to the control group. They displayed greater patience in exploring the reasons behind the generation of sound. Compared to the control group, the experimental group demonstrated a higher ability to incorporate quotations. For example, in the case of the Changsha Kiln firing incident, 82% of the participants used historical allusions or famous quotes to express their sadness, such as "No member escapes unscathed from a family disaster." After listening to the sound narration, nearly 67% of the users were able to infer historical changes by recognizing changes in tone or the characteristic features of objects. For example, they identified that "The pottery changed from weakness to triumph and then declined" or that "The sound implied destiny." Sound narration can stimulate users' active learning and enhance memory. 88% of the participants in the experimental group actively asked more questions during the recall interviews, such as "Does the gender of the sound affect people's associative effects? are there women among the kiln workers?" Results from the bloom's taxonomy-based questionnaire indicated that the experimental group achieved higher memory scores, with the experimental group achieving an accuracy rate of 80%, the control group had an accuracy rate of 70%. However, from the interviews and questionnaires, it was observed that the two groups had different memory preferences. The control group focused more on the product's appearance and craftsmanship, whereas the experimental group placed greater emphasis on cultural stories, particularly regarding customs and historical narratives. The bloom questionnaire revealed that the experimental group demonstrated superior performance in the dimensions of comprehension and analysis, enabling them to draw connections among political, economic, and cultural contexts, and to elucidate the interrelations among these aspects. For instance, one participant cited *The An Shi Rebellion* as an illustrative example. Furthermore, we also found that experimental group users showed high confidence in the events described in the sound narration, such as "Although i'm not familiar with history, i am certain about how the sound is produced." The study suggests that sound can evoke a rich imagination and enhance users' comprehension abilities. They also demonstrated a more complete and logical retelling of the story during collaborative narration, while incorporating more historical references. In conclusion, the findings suggest that sound narration significantly improves participants' ability to retell stories, incorporating a richer array of historical references.

4.2 Affective

This category encompasses user emotions, including emotion understanding, emotion expression, and emotion regulation. Emotion understanding involves comprehending character emotions, as exemplified by statements such as "I sense a sadness akin to that of a kiln worker," while emotion expression refers to how emotions are conveyed through facial expressions or body language, such as users frowning, smiling, or appearing contemplative, and emotion regulation concerns adjusting emotions, as demonstrated when someone states "Initially proud of the era's technology, the outbreak of war and the potters' demise led me to reassess my feelings."

Two caveats merit attention regarding the "Affective talk" category. First, verbal measures serve as crude indicators of an exhibition's emotional impact at best. Capturing affective learning talk is valuable, and we believe that capturing the use of emotional words in conversations is a key aspect of reflecting users' emotional engagement. Roberts (1990) provides a comprehensive review of alternative methodologies for understanding affect. Second, visitors' expressions of displeasure do not inherently critique the exhibition. For example, although the sound of robbers smashing objects and harming kiln workers may elicit feelings of anger and sadness, it simultaneously deeply engages visitors and may even evoke a sense of immersion. 82% of the experimental group acknowledged that the sound enhanced their understanding of the emotional dimensions and historical context, fostering deeper reflection and a more nuanced comprehension. They demonstrated a more nuanced understanding and expression of emotions, for instance, deeply sensing the brutality of war and the powerlessness of the lower-class people through sound. In contrast, control group participants were more reserved, with some struggling to focus on the text and overlooking details they were not inclined to explore. They also noted the advantage of text in controlling reading pace. The bloom questionnaire revealed differences in expression between the two groups. The experimental group utilized more emotional and descriptive language in analyzing the questions, such as "The tiny monkey cuddling its mother, creating a highly heartwarming scene," while the control group used more precise vocabulary closely aligned with the text provided, for example,

"The techniques and production methods used in the ceramic creation of Changsha Kiln, such as under-glaze painting."

4.3 Conceptual

This category pertains to the cognitive interpretation by users of items they find intriguing within the exhibition. Discussions should not necessarily be abstract but ought to involve multiple steps and lead to insightful conclusions. The active construction of new knowledge is essential in the learning of cultural heritage. For instance, the experimental group asked additional questions to deepen their understanding of cultural heritage. The subcategories of conceptual talk include simple inference, which is an interpretive statement or interpretation of part of an exhibit. For example, "During the prosperous Tang Dynasty, people loved writing poetry, which they incorporated as decorations on ceramics." Complex inference involves generalizing exhibit information, formulating hypotheses, or discussing the relationship between objects or their properties. An example is "The item serves not only a functional purpose but also as a means for craftsmen to express their ideas through its shape, conveying their thoughts and memories." Prediction refers to an expectation of future events, including what visitors are about to see or do. For instance, "The Changsha Kiln culture is expected to regain prominence in public interest." Reflection involves considering one's current or previous state of knowledge, like "What inspired me is the idea of adding olfactory interaction to sound and tactile interactions."

Upon analyzing the discussions triggered by exhibition elements, we observed no significant differences between the experimental and control groups regarding simple inference and prediction. However, the experimental group demonstrated more profound and systematic conclusions in their complex inferences. Notably, 86% of its members discussed three or more dimensions, including "Policy," "Diplomacy," "National culture," "Writing," "Poetry," and "Ethnic minorities." In their reflections, the experimental group excelled in their mentions of "Future," "Self," "History," and "The fate of the people," totaling 26 times. They also contemplated the more effective application of their disciplinary knowledge (History, Ournalism, Design) in their future professional endeavors, discussing this application 14 times. Notably, a design student expressed an intention to explore the olfactory aspects of cultural heritage in future studies.

4.4 Connecting

This category focuses on the dialogue where users integrate cognitive aspects of an exhibition with their existing knowledge and experiences. Exhibits serve as catalysts for sharing personal stories or previously acquired information, marking a significant part of learning. The three subcategories include life-connection, knowledge-connection, and inter-exhibit connection. Life-connection involves making personal associations, likening elements of the exhibit to familiar experiences. For example, one might say, "This reminds me of the audio-books I read before, the male protagonist's voice captivates me." Knowledge-connection is about expressing prior knowledge, such as identifying a historical period of turmoil. Inter-exhibit connection involves drawing links between different elements of the exhibit, akin to comparing artifacts to the relationship between a father and son.

During our experimental process, we discovered that all instances of learning-related dialogue involved some degree of prior knowledge. This suggests that specific elements within the exhibition served as catalysts, prompting participants to recall additional knowledge or past experiences. In the experimental group, 82% of participants explicitly linked their observations to various knowledge domains, such as "Geography," "Diplomacy," and "Economics" actively drawing comparisons between exhibition elements and familiar concepts. Furthermore, 62% of these users referenced their past visitation experiences during discussions, linking them to previous learning encounters. Reflective interviews revealed that visitors in the experimental group were more actively engaged in sharing personal stories or previously acquired information, even when these narratives were not directly related to their current observations.

4.5 Strategic

This category captures the collective discussions and behavioral dynamics through which participants strategically engage with exhibits to co-create narratives. Use provides guidance on how to interact with exhibits. An example is instructions such as "Touch it like this to produce sound," which facilitate interactive engagement. Sharing which involves the dissemination of knowledge and the encouragement of participation, illustrated by invitations like "I'd like to share a topic with you." This subcategory emphasizes the importance of knowledge exchange and collaborative learning. Performance focuses on evaluating collaborative efforts, as seen when two participants acknowledge their agreement in a discussion through a congratulatory gesture, such as "High-five". By examining these subcategories, the study aims to understand the nuanced ways in which participants interact with the exhibition to collectively construct narratives and share knowledge.

Sound narration enhances interactive communication among visitors through use, sharing, and expression. The experimental group engaged more deeply, evidenced by longer viewing times and more frequent stops at exhibits. Notably, 85% of participants in the experimental group actively participated in discussions, especially during pauses by their interlocutors. They demonstrated increased physical engagement, including hand clapping, smiling, leaning forward, nodding, and arm crossing. They also offered verbal support, using phrases like "Yes, i agree," "I feel the same," and "Me too." We conclude that sound narration enhances learning, communication, and discussion among visitors. Cortez (2022) posits that sound can foster a highly social environment, encouraging dialogue and engagement. In contrast, visitors in the control group engaged in brief discussions, focusing on narrative elements or factual information without detailed explanations of their choices. They also showed a lower frequency of interactive behaviors and expressions.

5. Conclusion

This pilot exploration investigates the impact and potential of sound narration in the context of cultural heritage learning through a sound interactive ceramic installation based on Changsha Kiln. Sound narration serves to extend the history presented by the exhibits and establish new connections between visitors and cultural heritage. The results of the pilot study indicate that both qualitative and quantitative studies can validate the positive impact of sound narration on cultural heritage learners, influencing them in terms of perceptual, affective, conceptual, connecting, and strategic aspects. One limitation of this pilot study is the limited output of content from the corpus. We plan to integrate with artificial intelligence dialogue systems in the future to provide users with more detailed and accurate answers. Overall, the evaluation of the art installation experience was considered effective.

References

Allen, S. (2003). Looking for learning in visitor talk: A methodological exploration. In G. Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums* (pp. 265–309). Routledge. https://doi.org/10.4324/9781410606624-14

Candela, E., & de Visscher, E. (2023). Learning from “The sounding object”: Sound design in the critical reimagining of museum object narratives. *Design Issues, 39*(2), 57–71. https://doi.org/10.1162/desi_a_00717

Cao, Y., Ng, G. W., & Ye, S. S. (2023). Design and evaluation for immersive virtual reality learning environment: A systematic literature review. *Sustainability, 15*(3), 1964. https://doi.org/10.3390/su15031964

Chattopadhyay, B. (2017). Reconstructing atmospheres: Ambient sound in film and media production. *Communication and the Public, 2*(4), 352–364. https://doi.org/10.1177/2057047317742171
Chopra, B., Verma, K., Singhal, S., Dureja, R., Choudhury, S., & Gupta, N. (2021). Reality tales: Facilitating

user-character interaction with immersive storytelling. In *Extended abstracts of the 2021 CHI conference on human factors in computing systems* (pp. 1–7). https://doi.org/10.1145/3411763.3451522

Cortez, A. (2023). Sound as a producer of social spaces in museum exhibitions. *Curator: The Museum Journal, 66*(2), 317–328. https://doi.org/10.1111/cura.12547

Henninger, A. E., Jones, R. M., & Chown, E. (2003). Behaviors that emerge from emotion and cognition: Implementation and evaluation of a symbolic-connectionist architecture. In *Proceedings of the second international joint conference on autonomous agents and multiagent systems* (pp. 321–328). https://doi.org/10.1145/860575.860627

Hutchinson, R., & Eardley, A. F. (2023). "I felt I was right there with them": The impact of sound-enriched audio description on experiencing and remembering artworks, for blind and sighted museum audiences. *Museum Management and Curatorship*, 1–18. https://doi.org/10.1080/09647775.2023.2188482

Järvelä, S., Volet, S., & Järvenoja, H. (2010). Research on motivation in collaborative learning: Moving beyond the cognitive–situative divide and combining individual and social processes. *Educational Psychologist, 45*(1), 15–27. https://doi.org/10.1080/00461520903433539

Knight-Hill, A. (2019). Sonic diegesis: Reality and the expressive potential of sound in narrative film. *Quarterly Review of Film and Video, 36*(8), 643–665. https://doi.org/10.1080/10509208.2019.1593027

Kocielnik, R., Xiao, L., Avrahami, D., & Hsieh, G. (2018). Reflection companion: A conversational system for engaging users in reflection on physical activity. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 2*(2), 1–26. https://doi.org/10.1145/3214273

Li, J. (2022). Grounded theory-based model of the influence of digital communication on handicraft intangible cultural heritage. *Heritage Science, 10*(1), 126. https://doi.org/10.1186/s40494-021-00579-0

Marto, A., Craveiro, J., Pina, N., Belem, P., Costa, C., & Teixeira, L. (2022). A survey of multisensory VR and AR applications for cultural heritage. *Computers & Graphics, 102*, 426–440. https://doi.org/10.1016/j.cag.2021.10.001

Norrick, N. R. (2019). Collaborative remembering in conversational narration. *Topics in Cognitive Science, 11*(4), 733–751. https://doi.org/10.1111/tops.12378

Pietroni, E. (2021). Mapping the soundscape in communicative forms for cultural heritage: Between realism and symbolism. *Heritage, 4*(4), 4495–4523. https://doi.org/10.3390/heritage4040248

Tsepapadakis, M., & Gavalas, D. (2023). Are you talking to me? An audio augmented reality conversational guide for cultural heritage. *Pervasive and Mobile Computing, 92*, 101797. https://doi.org/10.1016/j.pmcj.2023.101797

Williams, R. A., Maus, G., & Styles, S. J. (2023). Sound evoked visual memory in narrative film. *PsyArXiv Preprints*. https://doi.org/10.31234/osf.io/mhvq5

About the Authors:

Jiaxin Chen is currently a third-year master's student at Hunan University in China. Her research area is digital cultural innovation design. She participated in the National Art Fund project in 2022.

Baosheng Wang is an associate professor and doctoral supervisor at the School of Design, Hunan University. His research focuses on cultural heritage communication, digital narrative of cultural heritage, and social design.

Acknowledgements: This research is supported by the Hunan Science and Technology Key Research Project (No. 2022GK2070), and Hunan Social Science Foundation (No. 19YBA085).

P/REFERENCES OF DESIGN

This contribution was presented at Cumulus Budapest 2024: P/References of Design conference, hosted by the Moholy-Nagy University of Art and Design Budapest, Hungary between May 15-17, 2024.

Conference Website
cumulusbudapest2024.mome.hu

Conference Tracks
Centres and Peripheries
Converging Bodies of Knowledge
Redefining Data Boundaries
Bridging Design and Economics
Speculative Perspectives
The Power of Immersion
The Future of Well-being
Taming Entropy: Systems Design for Climate and Change
Ways of Living Together
Cumulus PhD Network

Full Conference Proceedings
https://cumulusbudapest2024.mome.hu/proceedings

ISBN Volume 1: 978-952-7549-02-5 (PDF)
ISBN Volume 2: 978-952-7549-03-2 (PDF)

DOI Volume 1: https://doi.org/10.63442/IZUP8898
DOI Volume 2: https://doi.org/10.63442/TADX4016

Conference Organisers
Moholy-Nagy University of Art and Design Budapest (MOME)
mome.hu
Cumulus Association
cumulusassociation.org