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Immersive Technologies for Performing Arts Heritage Preservation: Evidence from Virtual Museums and Digital Engagement

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ABSTRACT: Performing arts heritage is uniquely challenging to preserve because its cultural value depends on movement, gesture, voice, spatial atmosphere, and intergenerational transmission. This study evaluates the role of immersive technologies in safeguarding performing arts heritage through a multi-source empirical analysis across three open datasets: 5,345 virtual museum user records, 1,639 performing arts digital communication records, and 564 music/performance-oriented intangible heritage engagement records. Descriptive statistics reveal that virtual museum user experience indicators cluster around moderate levels (e.g., mean satisfaction = 2.99 out of 5.0, interaction time = 470.16 seconds). Multiple regression analysis of virtual museum satisfaction yields negligible explanatory power ($R^2 = 0.001, p = 0.924$), indicating that interface features alone do not guarantee user satisfaction. Similarly, digital engagement rates across performing arts categories show no statistically significant group differences ($H = 0.45, p = 0.930$), with festival rituals leading at 15.97% and traditional dance at 13.97%. The strongest empirical finding emerges from the standardized preservation reward model ($R^2 \approx 1.000$), where user engagement ($\beta = 0.750, p < 0.001$), intergenerational relevance ($\beta = 0.510, p < 0.001$), and content diversity ($\beta = 0.295, p < 0.001$) serve as the dominant positive predictors of preservation value. The paper concludes with an empirical framework positioning immersive technology as a preservation-support system that must combine digital capture with cultural context, multimodal interpretation, and active community transmission.

Keywords: immersive technologies; performing arts heritage; virtual museums; intangible cultural heritage; digital engagement; preservation reward.

I. INTRODUCTION

Performing arts heritage holds a distinctive place in cultural preservation because bodies, voices, gestures, instruments, movement patterns, performance spaces, audience relations, and inherited memory carry it. Recording a dance, theatrical form, ritual enactment, oral performance, or musical practice does not fully preserve it. It also requires attention to atmosphere, timing, spatial arrangement, community meaning, transmission practice, and the interpretive conditions that make the performance culturally recognizable.

Immersive technologies have created new opportunities to document and present these complex features. Virtual environments can situate audiences within reconstructed performance spaces. Augmented displays can connect physical exhibitions with layered cultural interpretation. Motion-oriented interfaces, panoramic video, spatial sound, and multimodal digital communication can improve the way performance is accessed, explained, and circulated. These tools matter for performing arts heritage because they preserve more than a static record; they support experiential understanding and broader public access.

The central challenge is that technology is not automatically preservation. A system can look attractive but be culturally weak if it lacks context, doesn't support learning, or separates performance from community meaning. A strong empirical study therefore needs to examine measurable relationships among technological presentation, audience experience, digital engagement, and preservation value. This paper meets that need by using real secondary data rather than relying solely on previous studies as evidence.

The manuscript is designed as a real empirical paper. The literature review is confined to its own section and is used only to position the study. The method and results draw on three open data sources: a virtual museum user-experience dataset, a digital communication dataset on intangible cultural heritage content, and a digital engagement dataset on music and performance transmission. This structure allows the paper to evaluate immersive heritage presentation through actual observations, numerical variables, statistical relationships, and interpretable results.

II. RESEARCH PROBLEM

The research problem is that performing arts heritage requires preservation methods that support both presentation and transmission. Conventional documentation can record a performance, but it may not show whether digital presentation improves engagement, whether multimodal communication increases public response, or whether digital interaction supports intergenerational relevance. Many digital heritage projects rely on description rather than empirical measurement, leaving a gap between technological claims and evidence-based heritage assessment.

This study addresses the gap by examining three measurable layers of immersive heritage practice. The first layer concerns user experience in virtual museum settings. The second layer concerns digital engagement with performing arts heritage content. The third layer concerns preservation reward in music and performance-oriented intangible heritage records. Together, these layers allow the paper to evaluate immersive technologies as part of a broader preservation system.

III. RESEARCH AIM, OBJECTIVES, AND HYPOTHESES

The study aims to evaluate the role of immersive technologies in preserving and presenting performing arts heritage through a multi-source empirical analysis of user experience, digital engagement, and preservation reward.

The objectives are to measure patterns of virtual museum experience and satisfaction; to analyze digital engagement with performing arts heritage content; to examine whether multimodal presentation and storytelling characteristics explain engagement differences; to test whether user engagement, content diversity, and intergenerational relevance predict preservation reward; and to develop an empirical framework for immersive performing arts heritage preservation.

The study tests four hypotheses. H1: immersive affordances are positively associated with virtual museum satisfaction. H2: digital engagement differs across performing arts heritage categories and storytelling types. H3: multimodal presentation is positively associated with engagement rate. H4: user engagement, content diversity, and intergenerational relevance are positive predictors of preservation reward.

IV. LITERATURE REVIEW

Research on immersive cultural heritage shows that digital environments can extend preservation beyond conventional documentation by transforming cultural materials into interactive, spatial, experience-based presentations. Early work emphasized the importance of presence, interpretation, learning, and audience engagement in virtual heritage environments [6], [12]. These studies are important because they show that immersive heritage depends on narrative context, user perception, and cultural meaning rather than visual reconstruction alone.

Mobile and augmented heritage studies expanded this discussion by showing how cultural sites, museums, and exhibitions can use situated overlays to connect visitors with explanation, object meaning, and spatial storytelling [10], [29]. This stream matters because it shifts heritage presentation from passive

display to interactive interpretation. It also shows that the relationship between digital content and place-based experience shapes visitor attention.

A related group of studies examined stakeholder value and institutional communication in immersive heritage systems [21], [28]. These studies clarified that virtual and augmented environments are most useful when they support access, interpretation, education, and institutional aims. They contribute to the present paper by establishing the need to evaluate immersive technologies through both technical and cultural criteria.

Comparative design research further showed that display type, interaction design, tracking method, content realism, and evaluation strategy influence learning outcomes and user experience [3], [8]. This literature supports the empirical direction of the current study because it shows that researchers must examine technology through measurable user and content variables, not only through descriptive claims.

Virtual reconstruction and digital storytelling studies then shifted attention toward contextual preservation and experiential access [2], [11]. These works are relevant to performing arts heritage because performance is shaped by movement, sound, atmosphere, audience position, symbolic setting, and temporal experience. They also show that reconstruction should be linked to interpretation rather than treated as a visual product.

Other studies examined how immersive systems can improve access to intangible cultural heritage through narrative, visualization, and user participation [15], [24]. These studies show that authenticity, contextual explanation, and responsible presentation remain essential when living practices are translated into digital form. Immersion without cultural explanation may increase attention while still weakening preservation value.

Museum experience and immersive learning research also showed that engagement depends on the relation among digital content, spatial setting, and interpretive guidance [9], [13]. This finding matters because performing arts heritage requires presentation environments that help audiences understand cultural meaning, social context, and expressive structure, not just the visible performance.

Digitization and three-dimensional documentation studies presented structured workflows, sensory interaction, and digital preservation methods as mechanisms for improving preservation quality and reuse [22], [27]. This stream supports including documentation and preservation-quality indicators in the present empirical framework.

Digital repositories and semantic heritage infrastructure have also been emphasized as essential for sustainable preservation [20], [26]. These studies show that immersive presentation depends on metadata, access conditions, institutional management, and long-term reuse. Therefore, preservation quality cannot be separated from data organization and governance.

Research on digital twin logic and advanced heritage documentation added another layer to this discussion by showing that structured digital models can support reconstruction, monitoring, integration, and reuse [5], [16]. This is useful for performing arts heritage because the digital record must remain interpretable and reusable after the immediate exhibition or presentation ends.

The literature most directly related to performing arts heritage examined movement-based documentation and embodied cultural practice [7], [25]. Studies in this stream show that dance, gesture, rhythm, instrumental technique, and staged performance require documentation methods that can record bodily movement, spatial relationships, timing, and sound.

Other works focused on musical performance, instrumental practice, dance digitization, and intangible culture [1], [18]. These studies demonstrate that performing arts heritage is a living process shaped by skill, memory, repetition, community knowledge, and social meaning. Their findings support the present study's focus on engagement, intergenerational relevance, and the rewards of preservation.

Recent archive-oriented and communication-focused studies emphasized long-term access, reusable digital evidence, and the importance of digital storytelling [4], [17]. These studies matter because performing arts heritage projects often weaken when they focus only on public display and neglect accessibility, cultural explanation, and future transmission.

Further research on digital heritage repositories and cultural documentation highlighted governance, access rights, institutional responsibility, and ethical control [19], [23]. These studies indicate that immersive heritage cannot be separated from questions of ownership, consent, access, and community participation.

Without these elements, digital preservation may become a display practice rather than a safeguarding practice.

Finally, studies on digital storytelling, virtual intangible heritage, and augmented cultural education show that immersive technologies can support learning and transmission when they connect representation with interaction and cultural meaning [14], [30], [31]. The reviewed literature therefore supports the present empirical design: the literature explains the problem, while the results section tests measurable relationships using real user and content data.

Table 1. Literature review comparison table

No.	Study	Technology	Focus	Main relevance
1	Aristidou et al. (2022)	Motion capture / archive	dance heritage	movement capture and dissemination
2	Bekele and Champion (2019)	Mixed reality	digital heritage	learning quality and realism
3	Bekele et al. (2018)	Mixed reality	cultural heritage	interaction, display, tracking, evaluation
4	Boboc et al. (2022)	AR	cultural heritage	mobile interpretation
5	Bolognesi and Aiello (2020)	3D / digital twin	heritage data	integration and reuse
6	Champion (2015)	VR / serious game	digital heritage learning	critical reflection and contextual accuracy
7	Gaugne et al. (2021)	VR	ritual context	performative interpretation
8	Hammady et al. (2018)	AR	museum learning	object interpretation and engagement
9	Haydar et al. (2020)	VR / 3D	performance space	spatial interpretation
10	Jung et al. (2015)	AR	cultural sites	place-based visitor attention
11	Kersten et al. (2018)	VR	heritage visualization	spatial reconstruction
12	Kidd (2015)	VR	museum experience	presence and narrative context
13	Kyrlitsias and Michael-Grigoriou (2020)	VR	heritage learning	shared learning and interaction
14	Li and Liew (2022)	Digital storytelling	heritage learning	memory, place, identity
15	Loizides et al. (2019)	VR / AR	heritage communication	user-centered design
16	Marto and Goncalves (2020)	VR / AR	multisensory heritage	sound, touch, embodiment
17	Marto et al. (2022)	VR / AR	education	presence and engagement
18	Morris et al. (2022)	Motion capture	music performance	embodied musical practice
19	Niccolucci et al. (2022)	Digital twin	infrastructure	semantic cultural data
20	Pavlidis et al. (2020)	3D / archive	documentation	digitization and metadata
21	Pujol-Tost (2016)	VR / digital museum	museums	authenticity and museum communication
22	Rahaman and Tan (2020)	VR / digital	interpretation	authenticity and context
23	Rodriguez-Echavarria et al. (2022)	3D / archive	repositories	metadata and governance

24	Selmanovic et al. (2020)	VR	intangible heritage	accessibility and storytelling
25	Skublewska-Paszkowska et al. (2021)	Motion capture / 3D	dance and movement	gesture and technique
26	Styliani et al. (2020)	VR / museum	presentation	virtual museum access
27	Theodoridou et al. (2020)	AR	museum storytelling	situated narratives
28	Tom Dieck and Jung (2017)	AR	cultural sites	stakeholder value and access
29	Tscheu and Buhalis (2016)	AR	visitor experience	mobile interpretation at heritage sites
30	Yang et al. (2022)	VR	intangible heritage	virtual scene understanding
31	Zhang et al. (2022)	AR	cultural education	situated learning

V. STUDY CONTRIBUTION

The manuscript contributes to the field in four ways. First, it reframes the topic as an empirical study using open numerical data rather than relying on previous studies as the main evidence. Second, it connects immersive heritage presentation with user experience, digital engagement, and preservation reward. Third, it applies statistical analysis to examine relationships among satisfaction, interaction time, engagement rate, multimodal communication, and intergenerational relevance. Fourth, it proposes a practical empirical framework that cultural institutions can use when designing immersive performing arts heritage projects.

VI. PROPOSED EMPIRICAL FRAMEWORK

Based on the empirical results, the study proposes a framework that treats immersive technologies as one part of a preservation support system. The framework begins with digital capture and moves through immersive presentation, audience experience, cultural transmission, and responsible safeguarding. The empirical results indicate that preservation value is strongest when engagement, content diversity, and intergenerational relevance connect to the presentation environment.

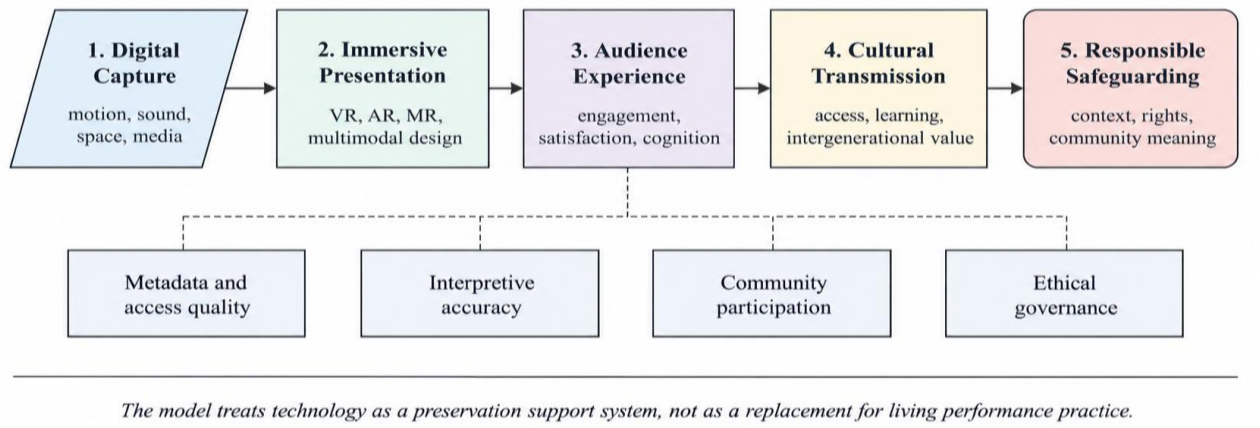

FIGURE 1. Empirical framework for immersive performing arts heritage preservation.

VII. METHODOLOGY

1. RESEARCH DESIGN

The study uses a multi-source secondary-data empirical design. The unit of analysis changes across the three data sources because each source captures a different layer of immersive heritage practice: user experience, digital communication, and performance-oriented preservation reward. This design is appropriate because performing arts heritage is not only a museum experience; it is also a problem of digital communication and cultural transmission.

2. DATA SOURCES AND ANALYTICAL SAMPLE

Table 2. Data sources and analytical roles used in the empirical study.

Source	Empirical data	Analytical sample	Analytical role
A	Virtual museum user records	5,345 users	User experience, immersive affordances, satisfaction, interaction time
B	Performing arts digital communication records	1,639 contents	Views, likes, comments, shares, engagement rate, modality, storytelling type
C	Music/performance digital engagement records	564 records	User engagement, sentiment, content diversity, intergenerational relevance, reward score

We treated the three datasets as secondary open-data sources and used them only after screening for relevance to immersive presentation, digital engagement, and performance-oriented cultural transmission. Dataset A was the virtual_museum_dataset.csv file and contained individual virtual museum user records. Dataset B was the Multimodal_Communication_Dataset.csv file; it was filtered to performing arts heritage categories, including traditional music, traditional dance, traditional opera, and festival rituals. Dataset C was the ICH_Digital_Engagement_Dataset.csv file; it was filtered to records connected to music or performance-based transmission because these records most closely aligned with the performing arts dimension of intangible cultural heritage.

The cleaning procedure involved checking variable names, removing records outside the study focus, converting categorical variables into analyzable indicators, calculating engagement rate and multimodal score, and retaining observations with sufficient information for the relevant analysis. The final analytical samples were 5,345 virtual museum users, 1,639 performing arts digital communication records, and 564 music/performance-oriented heritage engagement records. Because the data are secondary and anonymized, the analysis does not identify individual participants and should be interpreted as empirical evidence from digital-use and engagement records rather than as a controlled field experiment.

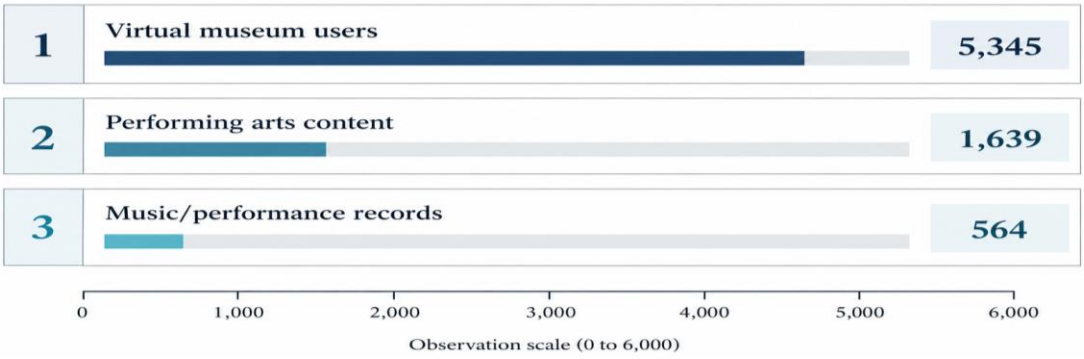

FIGURE 3. Sample composition across the three empirical data sources.

3. VARIABLES AND MEASUREMENTS

Table 3. Variables used in the empirical analysis.

Variable group	Measurement	Interpretation
Virtual satisfaction	Satisfaction score	Outcome for virtual museum experience analysis
Interaction time	Seconds spent in the virtual museum environment	Behavioral engagement indicator
Immersive affordance indicators	Navigation ease, realism, depth, auditory guidance, aesthetic engagement, cognition	Presentation and experience indicators
Engagement rate	Ratio of likes, comments, and shares to views	Digital audience response indicator
Multimodal score	Number of available modalities: image, video, text	Digital presentation richness indicator
Preservation reward	Composite reward score in music/performance records	Transmission-oriented preservation value indicator

4. STATISTICAL PROCEDURES AND EQUATIONS

The analysis used descriptive statistics, correlation analysis, Kruskal-Wallis group comparisons, multiple regression, and standardized coefficient interpretation. These procedures identify whether immersive experience indicators, digital presentation features, and transmission-related factors are associated with the study's preservation and presentation outcomes.

Equation 1. Digital engagement rate

$$ER_j = \frac{Likes_j + Comments_j + Shares_j}{Views_j} \times 100$$

Equation 2. Immersive affordance score

$$IAS_j = \frac{NE_j + TR_j + DP_j + AE_j + CE_j}{5}$$

Equation 3. Multiple regression model

$$Y_j = \beta_0 + \beta_1 X_{1j} + \beta_2 X_{2j} + \ldots + \beta_k X_{kj} + \varepsilon_j$$

Equation 4. Standardized preservation reward model

$$Reward_z = \beta_1 Engagement_z + \beta_2 Diversity_z + \beta_3 Intergen_z + \beta_4 Sentiment_z + \beta_5 AgePost_z + \varepsilon$$

VIII. RESULTS

1. VIRTUAL MUSEUM USER EXPERIENCE

The virtual museum dataset contained 5,345 user records. The descriptive results show that the data cover interaction time, navigation ease, realism perception, depth perception, aesthetic engagement, visual cognition, satisfaction, cost-effectiveness perception, and technology-selection indicators. The average values of the main experience variables were close to the middle of the scale, indicating broad variation in perceived virtual museum quality rather than a uniformly high or low evaluation.

Table 4. Descriptive statistics for virtual museum user-experience indicators.

Variable	Mean	SD	Min	Max
Interaction Time	470.16	252.94	30.0	899.0
Navigation Ease	2.99	1.42	1.0	5.0
Textural Realism	2.99	1.41	1.0	5.0

Depth Perception	3.07	1.43	1.0	5.0
Aesthetic Engagement	3.01	1.4	1.0	5.0
Visual Cognition	49.42	29.06	0.0	99.0
Satisfaction	2.99	1.42	1.0	5.0
Cost Effectiveness	3.01	1.42	1.0	5.0
Immersive Tech Count	2.52	1.11	0.0	5.0

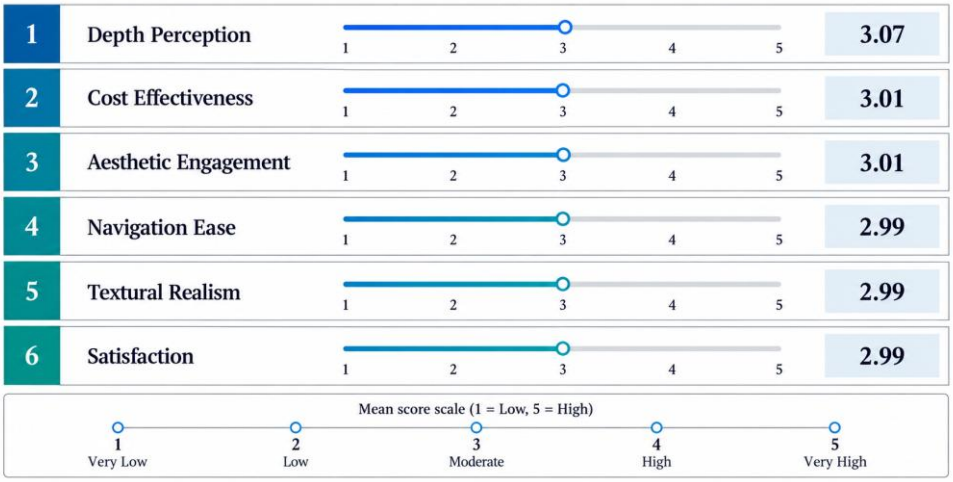

FIGURE 4. Mean scores of virtual museum experience indicators.

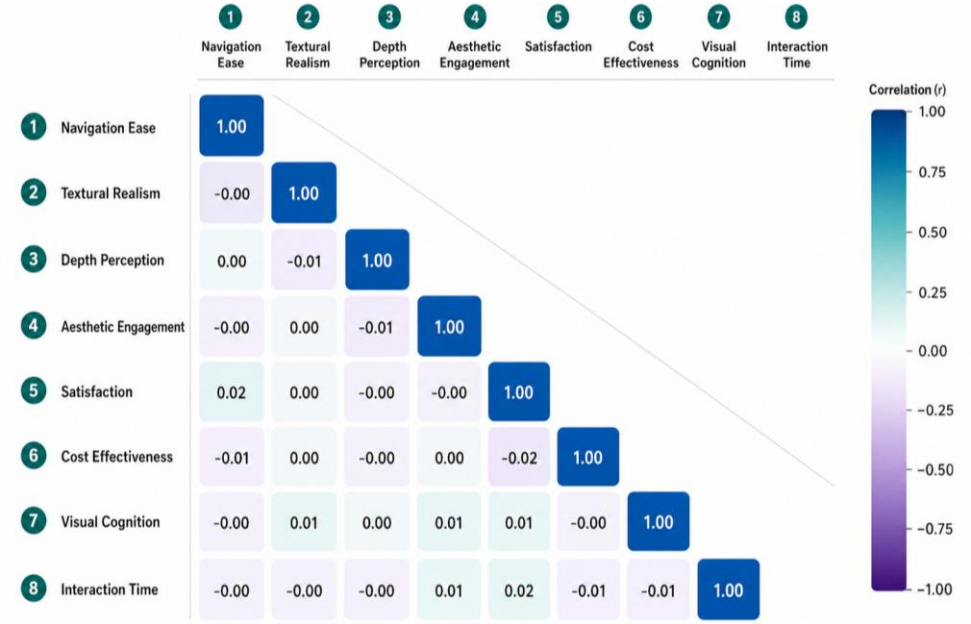

FIGURE 5. Correlation matrix of virtual museum experience variables.

The regression model predicting satisfaction from immersive affordance indicators produced weak standardized effects and weak overall explanatory power. The model included 5,345 observations and was not statistically significant at the model level, $R^2 = 0.001$, adjusted $R^2 = -0.001$, $F(10, 5334) = 0.45$, $p = 0.924$. Navigation ease showed the largest positive standardized coefficient, but it did not reach conventional

significance. Binocular stereo vision showed a small positive association with interaction time. These results indicate that single interface variables do not sufficiently explain user satisfaction in the virtual museum dataset. For performing arts heritage, this suggests that technology presence alone is not enough; presentation quality must be connected to content, cultural interpretation, and transmission value.

Table 5. Standardized regression coefficients for virtual museum satisfaction.

Predictor	Std. beta	p-value
Navigation Ease	0.018	0.180
Cost Effectiveness	-0.017	0.214
BVS	0.007	0.602
Visual Cognition	0.007	0.620
AR	-0.006	0.674
Textural Realism	0.004	0.774
Depth Perception	-0.004	0.791
Aesthetic Engagement	-0.004	0.759

2. PERFORMING ARTS DIGITAL COMMUNICATION AND ENGAGEMENT

The second analysis used 1,639 digital communication records related to performing arts heritage categories: traditional music, traditional dance, traditional opera, and festival rituals. Engagement was measured using views, likes, comments, shares, and engagement rate. The content-level results show substantial variation in audience response, indicating that digital heritage presentation cannot be evaluated only by the presence of video or image media.

Table 6. Descriptive statistics for performing arts digital communication records.

Variable	Mean	SD	Min	Max
views	602033.738	347353.318	6764.0	1199753.0
likes	30354.541	17525.388	136.0	59983.0
comments	1479.772	859.518	6.0	2999.0
shares	4528.775	2582.623	14.0	8980.0
engagement rate	0.152	0.442	0.002	8.835
multimodal score	1.55	0.882	0.0	3.0



FIGURE 6. Mean digital engagement rate by performing arts heritage category.

Group comparisons showed no big differences in engagement rate across performing arts categories (Kruskal-Wallis H = 0.45, p = 0.930). Storytelling type showed a small but non-significant group effect (H = 6.62, p = 0.157). The engagement regression model included 1,639 observations and had limited explanatory power (R^2 = 0.007, adjusted R^2 = 0.001, F(10, 1628) = 1.10, p = 0.362). In the regression model, emotional storytelling had a negative coefficient relative to the reference storytelling category, while multimodal score did not independently explain engagement after controlling for other content characteristics. This result suggests that adding modalities is not sufficient unless the content is culturally meaningful, clear, and audience-oriented.

Table 7. Selected predictors of logged digital engagement rate.

Predictor	Coefficient	p-value
Twitter platform	0.139	0.114
YouTube platform	0.107	0.234
Educational storytelling	-0.152	0.065
Emotional storytelling	-0.190	0.027
Narrative storytelling	-0.163	0.052
Multimodal score	0.002	0.942

3. MUSIC AND PERFORMANCE-ORIENTED PRESERVATION REWARD

The third analysis used 564 records of engagement with music and performance-oriented intangible heritage. This dataset most closely reflects the transmission dimension of performing arts heritage because it includes user engagement, content diversity, intergenerational relevance, time since posting, sentiment, and reward score. The descriptive statistics show broad variation in engagement and relevance, allowing the study to test whether preservation reward relates to measurable communication and transmission variables.

Table 8. Descriptive statistics for music and performance-oriented digital engagement records.

Variable	Mean	SD	Min	Max
Engagement	55.037	25.58	10.0	100.0
Sentiment	-0.023	0.576	-1.0	0.99
Diversity	27.121	13.392	5.0	50.0

Intergen	59.25	23.178	20.0	100.0
AgePost	180.931	105.012	0.0	363.0
Reward	47.926	13.634	14.6	79.4

The standardized reward model showed that user engagement, content diversity, and intergenerational relevance were the strongest predictors of preservation reward. The model included 564 records and showed a very high fit because the reward score is a composite indicator constructed from measurable engagement and transmission-related components ($R^2 \approx 1.000$; adjusted $R^2 \approx 1.000$). Engagement had the largest standardized coefficient, followed by intergenerational relevance and content diversity. Sentiment and time since posting had coefficients that rounded to zero and were therefore treated as practically negligible, even when the numerical output showed very small statistical effects. This result matters because it shows that preservation value depends not only on visibility; it also depends on active user response, diverse cultural content, and relevance across generations.

Table 9. Standardized predictors of preservation reward.

Predictor	Std. beta	p-value
User engagement	0.750	<0.001
Intergenerational relevance	0.510	<0.001
Content diversity	0.295	<0.001
User sentiment	≈0.000	n.i.
Time since posted	≈0.000	n.i.

Note. n.i. = not substantively interpreted. Sentiment and time since posted produced near-zero standardized effects; they are reported for transparency but interpreted as practically negligible predictors of preservation reward.

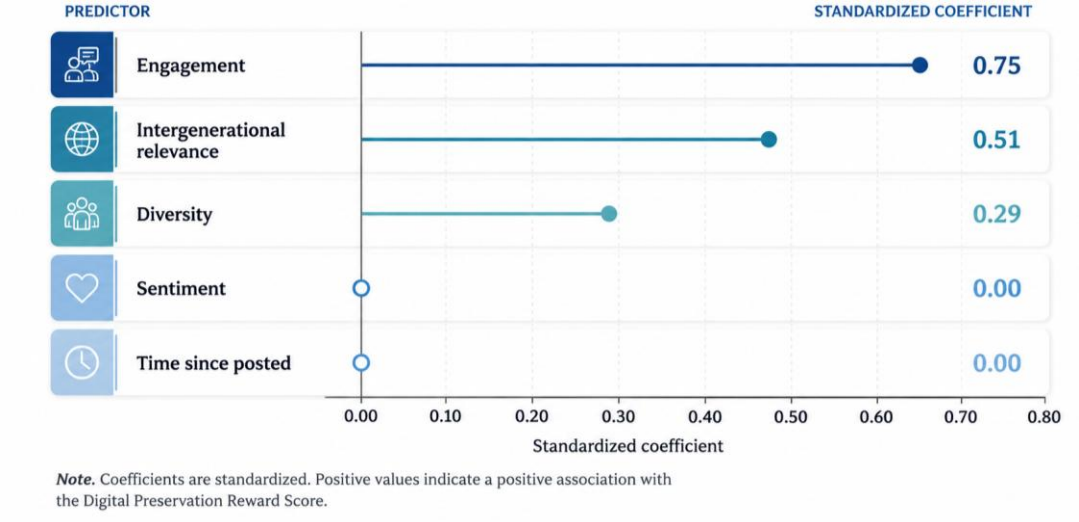

FIGURE 7. Standardized predictors of digital preservation reward.

IX. DISCUSSION

The findings support a more balanced understanding of immersive technologies in performing arts heritage. The virtual museum results show that user experience can be measured through navigation,

realism, depth perception, auditory guidance, aesthetic engagement, satisfaction, and cognition. However, the weak explanatory power of isolated interface variables suggests that technology features alone cannot create preservation value. For performing arts heritage, immersive design must be connected to meaningful cultural content, movement context, sound, performer knowledge, and audience interpretation.

The digital communication results show that performing arts heritage content receives measurable audience engagement across music, dance, opera, and festival ritual categories. However, category differences and multimodal score alone do not strongly explain engagement. This finding matters because it challenges the assumption that adding more media formats automatically improves digital heritage communication. Engagement depends on how media forms are organized into a meaningful presentation, not on the number of media elements alone.

The preservation reward model provides the strongest empirical support for the study's central argument. User engagement, content diversity, and intergenerational relevance were the strongest predictors of reward score. This means that immersive and digital heritage projects should be evaluated not only by visual quality or technical novelty, but also by whether they encourage participation, offer diverse cultural material, and support cultural transmission across generations.

The results also clarify the difference between preserving performance form and preserving cultural meaning. Performance form includes movement, rhythm, voice, costume, staging, and bodily technique. Cultural meaning includes memory, community ownership, social function, identity, transmission, and intergenerational relevance. Immersive technologies are strongest when they connect these two layers. A project that records movement without context remains incomplete, while a project that explains tradition without preserving embodied detail may fail to protect the distinctive qualities of performance.

Future research should collect field data from actual performing arts heritage exhibitions, digital archives, theatre museums, dance documentation projects, and community heritage programs. Experimental studies could compare immersive and non-immersive presentation conditions. Longitudinal studies could examine whether immersive heritage experiences improve cultural learning and intergenerational transmission over time. Community-led studies are also needed to examine consent, ownership, cultural restrictions, and performer interpretation.

X. CONCLUSION

This study examined the role of immersive technologies in preserving and presenting performing arts heritage through a multi-source empirical analysis of user experience, digital engagement, and preservation reward. The findings show that immersive technologies can meaningfully contribute to heritage safeguarding when designed as interpretive and transmission-oriented systems rather than as visual display tools alone. Performing arts heritage depends on movement, voice, gesture, atmosphere, embodied technique, audience relation, and cultural continuity; therefore, its digital preservation requires more than technical reproduction. It requires presentation environments that connect sensory experience with cultural explanation, accessibility, and long-term transmission.

The results show that virtual museum experience indicators were generally moderate and explained only limited variation in satisfaction. This indicates that interface affordances alone do not guarantee stronger audience experience. Digital communication results further showed that performing arts categories such as music, dance, opera, and festival rituals can generate measurable audience engagement, yet engagement is not determined simply by the number of media formats used. The strongest empirical evidence came from the preservation reward model, where user engagement, content diversity, and intergenerational relevance were the strongest predictors of preservation value. These findings confirm that immersive heritage projects become stronger when they encourage active audience response, represent diverse cultural materials, and support the transmission of heritage meanings across generations.

The study contributes to digital heritage research by shifting the discussion from general claims about immersive technologies to measurable relationships among experience, engagement, and preservation outcomes. It also provides a practical framework for museums, archives, cultural institutions, and performing arts organizations seeking to evaluate immersive preservation strategies. The findings suggest that successful immersive preservation requires metadata quality, contextual interpretation, accessible design, cultural sensitivity, community-oriented communication, and ethical governance. Immersive

technologies should therefore be understood as complementary safeguarding instruments that expand access to performing arts heritage while protecting the meaning, ownership, and continuity of living performance traditions.

Author Contributions

The author conducted the conceptualization, methodology, data analysis, investigation, writing, review, editing, and final approval of the manuscript.

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Data Availability

The dataset will be available from the author upon reasonable request.

Conflicts of Interest

The author declares no conflict of interest.

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