Wrapped in Anansi's Web: Unweaving the Impacts of Generative-AI Personalization and VR Immersion in Oral Storytelling

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Abstract

Oral traditions, vital to cultural identity, are losing relevance among youth due to the dominance of modern media. This study addresses the revitalization of these traditions by reconnecting young people with folklore. We introduce **Anansi the Spider VR**, a novel virtual space that combines first-person virtual reality (VR) with generative artificial intelligence (Gen-AI)-driven narrative personalization. This space immerses users in the story of Anansi the Spider, empowering them to influence the narrative by envisioning themselves as the protagonists, thereby enhancing personal reflection. In a 2×2 between-subjects study with 48 participants, we employed a mixed-method approach to measure user engagement and changes in interest, complemented by semi-structured interviews providing qualitative insights into personalization and immersion. Our results indicate that personalization in VR significantly enhances engagement and cultural interest. We recommend that future studies using VR and Gen-AI to revitalize oral storytelling, maintain cultural integrity, and involve cultural communities to ensure authentic, respectful narratives.

CCS Concepts

• **Human-centered computing** → **User studies**; **Empirical studies in interaction design**; • **Applied computing** → **Interactive learning environments**; **Arts and humanities**; • **Computing methodologies** → Intelligent agents.

Keywords

VR, Gen-AI, Intangible Cultural Heritage, Education

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1 Introduction

> "Folklore at its best addresses both tradition and innovation and shows how constancy and change are interlinked in the dynamic process of civilization." - Wolfgang Mieder, 1987 [51]

Folklore embodies the balance of tradition and innovation, intertwining constancy and change in the evolution of civilization [51]. This is particularly true of oral traditions, which UNESCO classifies as a crucial aspect of intangible cultural heritage (ICH), describing them as "living expressions" passed down through generations via storytelling, music, and shared practices [79, 94, 95]. Oral traditions play a vital role in bridging the past and present, conveying knowledge, values, and beliefs while shaping worldviews through myths, fables, and folklore [17, 56, 89]. Vansina [99] highlights their importance in enabling societies without written records to reconstruct their history. Despite their cultural significance, the fluid and undocumented nature of oral traditions makes them vulnerable to distortion or loss. Challenges such as colonial legacies [39], globalization [45], and declining interest among younger generations [70, 89] further heighten this vulnerability. These factors underscore the need for innovative strategies to preserve and revitalize oral traditions as traditional methods struggle to remain relevant in the digital age.

Traditionally, oral traditions were passed down by storytellers who served as cultural guardians, conveying values and knowledge through vivid, participatory narratives [63, 92]. However, the decline in successors and erosion of traditional practices have weakened their transmission [92]. While projects like Digital Folklore [50] and Folk-Computing [8] have digitized narratives for global access, they often reduce oral traditions to static formats, failing to capture their dynamic and performative essence [32]. This limitation is particularly evident for younger, tech-savvy audiences who expect immersive and interactive experiences [15, 70, 86].

Throughout history, oral traditions have adapted to new mediums, maintaining their relevance across evolving cultural landscapes [50, 79, 99]. Unlike prior studies that focus solely on VR immersion or static narrative personalization, our research addresses this challenge by reimagining oral traditions as immersive, first-person experiences. By integrating the sensory engagement of virtual reality (VR) with the real-time adaptability of generative artificial intelligence (Gen-AI) powered by ChatGPT, our approach fosters cultural reflection while bridging generational and cultural divides, making traditional narratives more relatable and engaging for modern audiences.

Gen-AI and VR now serve as transformative tools to extend these traditions from specific cultural communities to global audiences. VR fosters a sense of embodiment, enabling users to deeply immerse themselves in culturally rich narratives [58, 62, 75, 76, 91], while Gen-AI dynamically adapts narratives in real-time, offering personalized and resonant storytelling experiences [24, 91, 108]. Together, these technologies broaden the reach and appeal of oral traditions by making narratives more interactive and relatable [13, 34, 55, 74]. By combining Gen-AI and VR, our work demonstrates how oral traditions can extend beyond their origins to engage audiences from diverse cultural backgrounds. This approach not only revitalizes traditional storytelling but also fosters cultural exchange, ensuring these narratives remain relevant in a rapidly digitizing and interconnected world [11, 26, 102].

In this exploratory study, we investigate how VR and Gen-AI may contribute to revitalizing storytelling through the example of Anansi the Spider. Central to Akan traditions, Anansi's narratives feature themes of kingship, storytelling, and resilience, with the character often depicted as a resourceful trickster and sage figure [20, 47, 67, 98]. Historically, these tales also served as symbols of resistance during the transatlantic slave trade, particularly in Afro-Caribbean communities [35, 48]. Given the enduring relevance of Anansi's stories, they offer a suitable case for exploring how emerging technologies can preserve and modernize oral traditions. Accordingly, our research addresses the following questions (RQs):

- **RQ1**: How does Gen-AI-driven personalization affect user engagement and interest in cultural learning among younger audiences during storytelling experiences?
- **RQ2**: How does VR immersion influence user engagement and interest in cultural learning among younger audiences during storytelling experiences?
- **RQ3**: How do personalization and immersion together enhance user engagement and interest in cultural learning, thereby supporting the transmission of oral traditions to younger audiences?

To answer our RQs, we conducted a 2×2 between-subjects design with 48 participants to evaluate the combination of Gen-AI and VR, specifically focusing on the effects of interaction medium (VR vs. Non-VR) and personalized content (Personalized vs. Non-Personalized) on folklore transmission. To the best of our knowledge, this is the first study to explore how the integration of VR immersion and Gen-AI personalization can dynamically adapt and enhance the transmission of culturally significant oral traditions. Our findings demonstrate that VR significantly enhances engagement and interest in cultural learning, while Gen-AI personalization fosters deeper narrative connections. Semi-structured interviews further highlight how personalized VR storytelling enhances immersion and fosters deeper reflection on the story. The contributions of this paper are fourfold and as follows:

System We introduce a novel VR experience of Anansi the Spider[1], blending immersive storytelling with Gen-AI personalization to preserve and modernize oral traditions.

Conceptual We propose a framework integrating traditional storytelling with adaptive Gen-AI, using modular prompting for culturally authentic NPC behaviors.

Empirical A mixed-methods study shows that VR immersion boosts engagement, while Gen-AI personalization fosters self-reflection and cultural connection.

Mapping We present a thematic model (Immersion, Personalization, Engagement, Reflection, Cultural Relevance, Technological Intervention), illustrating how VR and Gen-AI enhance cultural storytelling and inform future research.

2 Related Work

In this section, we examine the evolution of narrative technology and the digitalization of oral traditions. First, we explore Gen-AI's advancements in narrative personalization. Second, we discuss VR's role in preserving oral traditions and transitioning from static archives to immersive platforms. Finally, we highlight the contributions and limitations of these technologies and their combined potential for creating adaptive, culturally resonant storytelling experiences.

2.1 Gen-AI for Personalized Narrative Experiences

Narrative technologies have evolved from basic understanding and generation to now narrative intelligence, where AI can craft, tell, and respond to stories [74]. Early systems, such as the Script Applier Mechanism (SAM) and Plan Applier Mechanism (PAM) [78], focused on interpreting narratives through predefined scripts and plans. Tools like the Storytelling Agent Generation Environment (SAGE) [93] and 'Scheherazade' [41] introduced personalized storytelling and paved the way for interactive narrative design. Advancements in natural language processing (NLP) later enabled systems like 'Mimisbrunnur' [84] to assist authors in creating story outlines via AI planning, showcasing new adaptability in narrative creation. However, these earlier systems were often limited by static responses, constrained narrative flexibility, and reliance on predefined heuristics.

One key challenge in interactive storytelling is the narrative paradox. The idea of balancing user agency in shaping the story while maintaining a coherent, pre-authored plot [4, 75, 91]. Murray [54] defines user agency as "the satisfying power to take meaningful action and see the results of our decisions and choices." Recent advances in Gen-AI, such as OpenAI's GPT-4, address previous limitations by offering context-aware, real-time storytelling [105].

[1]https://youtu.be/_jiXVDvB_60?si=s2okXFvdocF9OFWg, last accessed on 19 November 2024

However, challenges like factual inaccuracies and cultural bias persist [25, 72]. Projects like Turing Quest [24] and NarrativePlay [108] demonstrate the potential of Gen-AI in gamified storytelling, using augmented reality markers and role-playing narratives to enhance interactivity. However, these projects largely focus on fictional scenarios and fall short when adapting to culturally rich oral traditions that aim to educate and preserve cultural authenticity.

In contrast, our research leverages Gen-AI to provide personalized responses, maintaining the original plot while fostering co-creative storytelling. This approach addresses the narrative paradox by balancing user agency with narrative coherence and preserving the relational and performative essence of oral traditions. By making storytelling adaptive, relatable, and culturally grounded, our work addresses **RQ1**.

2.2 VR for Revitalizing Oral Traditions in the Digital Era

Technological advancements have transformed how we preserve oral traditions, moving from static archives to immersive platforms. Early tools, such as metadata schemas [44] and interactive systems like 'i-balls' [8], improved documentation and facilitated co-present interaction, yet lacked the immersive settings and narrative complexity needed to capture the cultural depth and performative essence of oral storytelling. Younger audiences increasingly prefer interactive, visually rich formats, highlighting the need for more engaging approaches [2, 96]. Recognizing this demand, research such as 'narrative storyliving' [97] explores how immersive environments deepen engagement by enabling participants to actively contribute to the narrative.

VR immersion shows potential for enhancing user agency in a way that fosters cultural appreciation and deeper engagement. VR-based cultural educational projects have demonstrated that flexible, user-centered adaptations can enrich cultural literacy [2], cross-cultural understanding [1] and learning traditional knowledge [87], underscoring the importance of responsiveness in immersive cultural experiences. For example, 'The Book of Distance' [62] combines historical narratives with interactive storytelling to evoke empathy, but its linear structure limits adaptability. Similarly, 'The First-Person VR System' [58] immerses users in folklore through voice and gesture yet lacks the adaptive personalization needed for diverse audiences.

Our work builds on these efforts by integrating dynamic VR environments with real-time Gen-AI personalization. This combination responds to users' actions within the immersive space, delivering context-aware storytelling. Unlike prior approaches that rely on static cultural representations, purely immersive settings, or linear narratives, our approach emphasizes the performative aspects of oral traditions. By enabling real-time adaptation, we enhance user engagement and cultural appreciation, addressing **RQ2**.

2.3 Combining Gen-AI and VR for Culturally Adaptive Storytelling

Kenderdine et al. [36] introduced the concept of embodied museography, emphasizing immersion, interaction, and participation in digitizing ICH. Similarly, Pollock [69] highlights the dynamic and co-creative nature of oral traditions, where storytelling emerges through the interplay of teller, audience, and context. These insights underscore the importance of combining immersive digital affordances with the relational qualities of oral traditions to create culturally adaptive storytelling experiences. Building on this foundation, our work integrates VR and Gen-AI to preserve oral traditions while enhancing their relevance for culturally diverse audiences. Despite their independent potential in real-time personalization and immersive storytelling, the combined use of Gen-AI and VR for revitalizing oral traditions remains underexplored.

Recent studies, such as Hirzle et al. [30] and Bozkir et al. [9], have explored the intersection of AI and extended reality (XR) for personalized cultural experiences. While applications like revitalizing traditional sports [40] and dance [66] showcase the potential of AI-driven VR, they primarily focus on usability, offering limited insight into cultural impact. The Baba Yaga project [19], which adapts Eastern European folklore in immersive environments, represents one of the closest parallels to our research. However, it lacks user-driven voice input to interactively shape narratives, a key innovation of our work. Additionally, the project does not empirically evaluate how immersive storytelling fosters deeper cultural engagement, highlighting a gap that our study aims to address.

To bridge these gaps, we adopt a mixed-methods approach, combining semi-structured interviews and quantitative surveys to evaluate user engagement and cultural appreciation, drawing on Bahng et al.'s reflexive dimensions [5]. This strategy fosters user reflection within immersive storytelling contexts and builds on prior work that emphasizes the role of qualitative methods in exploring the broader implications of emerging technologies [29, 49]. By prioritizing cultural sensitivity and user perspectives, we ensure responsible, impactful applications that measure both technological effectiveness and cultural significance, addressing **RQ3**. Furthermore, introducing voice-enabled interactions and modular Gen-AI prompting for real-time narrative adaptation offers a participatory approach to immersive storytelling. In doing so, this integration bridges the gap between technological innovation and cultural preservation, advancing responsible and meaningful applications of emerging technologies.

3 Methods

This study explores the use of Gen-AI and VR technologies as tools for cultural preservation and engagement, focusing on Ghanaian Anansi folktales. To achieve this goal, we designed a user study, approved by the Institutional Review Board (IRB) of Technical University of Munich, and evaluated it through our prototype, Anansi the Spider VR. The prototype features a Gen-AI-driven NPC, Onini, enabling participants to interactively shape the traditional tale. The study compares personalized versus non-personalized story versions delivered through VR and non-VR mediums, evaluating their effects on user engagement, reflection, and cultural understanding. This section provides an overview of the technical implementation of Anansi the Spider VR, apparatus, user study design, procedures, participants, measures, and analyses.

3.1 Technical Implementation of Anansi the Spider VR

The background of this VR narrative experience is inspired by the Anansi tales, specifically adapted from the story *How it came about that the Sky God's stories came to be known as "Spider-stories"* [73], participants take a first-person perspective, joining Anansi in capturing Onini, the Python, to obtain the stories of the world from the Sky God Nyame. The narrative is streamlined for the VR medium and study constraints while preserving its core themes.

Central to this VR experience is Gen-AI, which enables natural, personalized interactions with NPCs, particularly with Onini, the Python. Gen-AI refers to systems capable of producing new content, such as text, speech, or images, based on training data [18]. Here, the VR system leverages multiple Gen-AI models to bring the NPCs to life. OpenAI's Whisper [59] is used for speech-to-text (STT) conversion, transcribing the player's spoken input. Then, ChatGPT, powered by GPT-4 [61], generates a contextual response, impersonating the NPC, based on the player's input. ElevenLabs [60] is used throughout the experience to dynamically generate the voices of the NPCs. Together, these technologies allow the NPCs to respond in real-time. We presented the system architecture in Figure 1. Each interaction begins with a 5-second recording window, followed by processing times ranging from 2 to 7 seconds. Latency primarily arises from ChatGPT's response generation and ElevenLabs' voice synthesis, varying with response length and complexity.

To ensure narrative consistency and personalized engagement, we employ advanced prompt engineering techniques. Building on reusable patterns for ChatGPT [101], the system assigns roles to ChatGPT (e.g., Onini, the Python) using modular prompts inspired by role-prompting and chain-of-thought reasoning [77, 101]. Prompts are divided into five distinct sections, general instructions, character attributes, state descriptions, scene context, and script instructions, shown in Table 1, allowing dynamic adjustments based on game states. During runtime, these sections are combined and updated in real-time, then sent along with the player's message as input to ChatGPT. This design ensures NPCs remain coherent with their personalities and adapt seamlessly to player interactions.

3.2 Apparatus

The study utilized a Varjo VR-3 (Model HS-6) head-mounted display (HMD) powered by a GeForce RTX 4080, Intel Core i7-13700K, and 32 GB of RAM, achieving 90 frames per second. Interaction in the VR condition was facilitated by HTC Vive Controller 2.0 and Steam VR Base Station 2.0, using Unity's XR Interaction Toolkit, as depicted in Figure 2a. The non-VR setup, illustrated in Figure 2b, included a Schenker desktop with similar specifications, a Dell P2314T monitor (1920 × 1080 resolution), and a Creative Fatal1ty HS-800 Gaming Headset covering a standard frequency range from 20Hz to 20kHz. This setup enhanced overall immersiveness by delivering clear audio that complemented the visual quality.

The VR game was developed in Unity 2021.3.33f1 LTS using the Universal Render Pipeline (URP) for optimized performance. Assets were sourced from the Unity Asset Store, TurboSquid, CGTrader, and Sketchfab, including the "Tropical Forest Pack" [85] Anansi's spider body [16], Onini the Python [81], and Nyame, depicted by an Ashanti moon mask [82]. Custom elements, such as Anansi's mask and clay huts, were modeled in Blender specifically for this project.

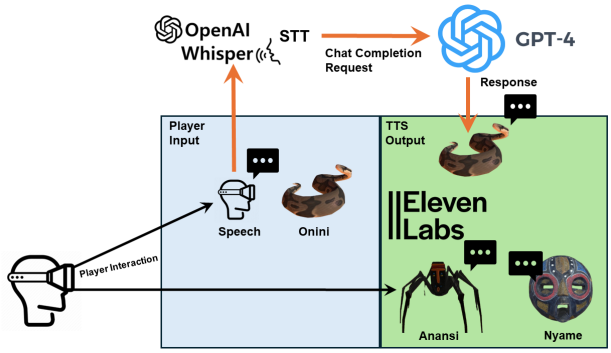


Figure 1: System architecture of the Player-NPC interaction model. Player speech is converted to text using Whisper, and GPT-4 generates dynamic NPC responses. The orange arrows represent communication between Whisper, GPT-4, and ElevenLabs, which processes player input and converts responses into speech. ElevenLabs handles both dynamic and pre-scripted text-to-speech outputs for NPCs.

Table 1: NPC Prompting Techniques in the VR Storytelling Experience.

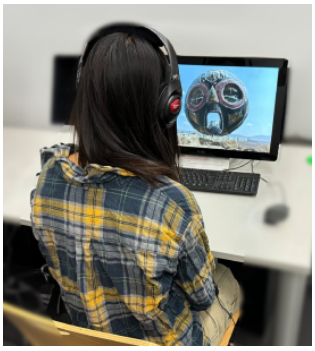
Instruction	Description	Example
General instructions	Defines NPC role and behavior.	*You are a character in an Anansi folklore VR game. Respond in character.*
Character attributes	Specifies NPC personality and traits.	*You are Onini, the prideful python from Anansi folklore.*
State description	Provides game state based on player actions.	*The player placed a bamboo beside you, challenging your boast.*
Scene context	Defines the setting where interaction occurs.	*You are coiled around a tree stump in a jungle clearing in Ghana.*
Script instructions	NPC responses and scripted actions.	*Stay coiled until persuaded, then proclaim: Behold the longest snake in Ghana!"*

ChatGPT integration for dialogue was implemented using an unofficial OpenAI Unity package [83], enabling dynamic interactions and Whisper services for STT. Eleven Labs, a Gen-AI-powered voice synthesis tool, provided text-to-speech (TTS) synthesis via an API [88].

3.3 User Study Design

We designed a 2 × 2 between-subjects experiment resulting in four conditions: **Non-VR Non-Personalized (NVNP)** (control), **Non-VR Personalized (NVP)**, **VR Non-Personalized (VNP)**, and **VR**

(a) Participant using the Varjo VR-3 headset with HTC Vive controllers for the VR condition.



(b) Non-VR setup with Creative Fatal1ty Headset, Schenker i7-13700K RTX 4080 desktop, and Dell P2314T monitor.

Figure 2: Experimental setup for VR and Non-VR conditions.

Personalized (VP). The two independent variables were **personalization** (Personalized vs. Non-Personalized) and **interaction medium** (VR vs. Non-VR). A total of 48 participants ($n = 48$) were randomly assigned across these four conditions ($n = 12$ each).

3.3.1 Personalization. In this research, we apply "personalization" by tailoring story content, such as character references, names, and key dialogue lines, to each participant. In the **Personalized** conditions, the narrative explicitly addressed participants using their chosen name and pronouns, and ChatGPT (acting as Onini) generated real-time dialogue in response to their negotiation attempts. Figure 9 (in the Appendix) illustrates this interaction with three user-generated narrations. In contrast, the **Non-Personalized** conditions referred to a generic character, "Anokye" (a common Akan name), and used only third-person references with pre-scripted dialogues. All conditions followed the same core story structure as shown in Figure 4, ensuring consistent plot progression and key events while permitting minor content adaptations (e.g., negotiation) in the personalized versions.

3.3.2 Interaction Medium. To understand the effect of VR, participants in the **VR** conditions (VNP, VP) experienced the narrative in an immersive environment as shown in Figures 3 and 4, where they could walk around, interact with objects, and negotiate directly with Onini. In VR Personalized (VP), ChatGPT dynamically responded to a participant's unique input and used their name in dialogue. In contrast, VR Non-Personalized (VNP) used the same interactive mechanics but referred only to "Anokye" and employed pre-scripted dialogue. In the **Non-VR** conditions (NVNP, NVP), participants progressed through a slide-based interface as shown in Figure 2b with audio narration. They could still advance through the story, and their interactions were pre-scripted chat elements generated by ChatGPT beforehand due to the nature of the interaction medium. Thus, NVP included each participant's name and minor adaptive text, whereas NVNP retained only generic references to "Anokye."

Figure 3: Interaction with Onini in the VR environment, where participants use Speech-to-Text options to persuade Onini to stretch alongside a bamboo stick, as part of their task in the 'Anansi the Spider VR' narrative.

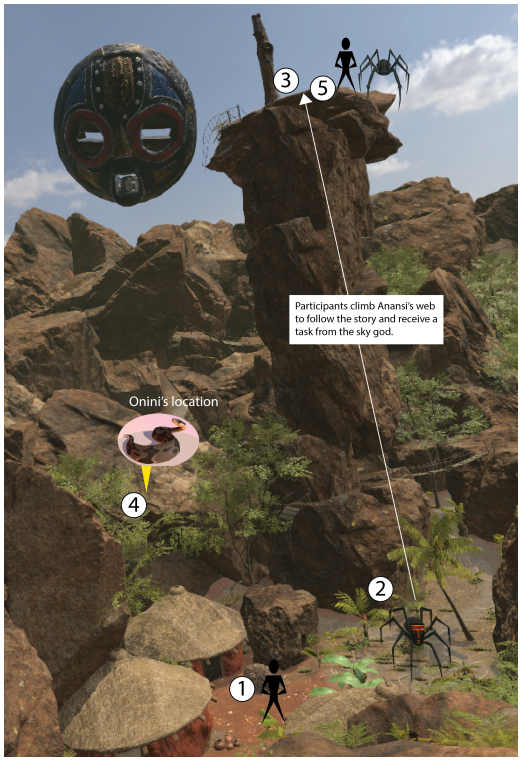


Figure 4: Interactive Narrative Path in 'Anansi the Spider VR': Figure illustrates the five key stages of the VR narrative. Participants start their journey at Stage 1 in the village, walking along a jungle path to Stage 2 where they meet Anansi, climb Anansi's web at Stage 3 to receive tasks from the Sky God, search for Onini at Stage 4, and conclude the experience at Stage 5.

3.4 Procedures

Each session lasted ≈ 50 minutes, with 30 minutes allocated for briefing, experimentation, and post-assessment, and an additional 20 minutes for semi-structured interviews. Data collection took place in a controlled laboratory setting. Eligible participants were

pre-screened based on assessment criteria and invited to take part. Upon arrival, participants were briefed on the research goals and signed informed consent forms, they were informed that they could withdraw at any time if they experienced motion sickness.

Following a height calibration step, which is crucial for tasks requiring precise spatial awareness in the VR environment [31, 104], participants received a five-minute tutorial covering VR navigation, NPC interactions, and object manipulation. The experiment began after this preparatory phase. During VR sessions, interaction data were automatically recorded in Unity, capturing metrics such as completion time, NPC interactions, and spatial coordinates. VR sessions concluded when participants clicked the "Exit" button after successfully capturing Onini and returning it to the Sky God, while non-VR sessions concluded with a video fade-out, indicating the end of the experience.

After the experience, participants completed a post-assessment questionnaire measuring engagement, story comprehension, and changes in cultural appreciation. Semi-structured interviews were conducted with a select group of 20 participants (saturation point), chosen from each of the four experimental conditions.

3.5 Participants

A total of 48 participants, aged 22 to 46 years ($M = 26.75, SD = 4.66$), including 25 males and 23 females, were recruited from a university student population. A pre-assessment questionnaire measured familiarity with digital storytelling ($M = 3.55, SD = 0.98$), VR ($M = 2.83, SD = 1.00$), oral traditions ($M = 2.63, SD = 0.94$), African culture ($M = 1.58, SD = 0.84$), and interest in other cultures ($M = 3.63, SD = 1.00$), as shown in Appendix Table 4. The demographic variance was consistent across the experimental conditions, ensuring a balanced representation in the study. Eligibility required participants to be over 18, fluent in English, and have normal or corrected vision. Those reporting severe motion sickness were excluded. Each participant received a €10 voucher for participation.

Semi-structured interviews were conducted with 20 participants from the original sample of 48. We recruited volunteers from each of the four experimental conditions to ensure coverage of different experiences. Interviews were conducted incrementally until data saturation was reached, e.g., when no substantially new insights or themes emerged, drawing on qualitative research principles from Longhurst [43], Hennink and Kaiser [28], and Adams [3]. Table 2 provides demographic details of the interviewed participants. These interviews explored personal reflections on the experience, perceived immersion, and emotional impacts, complementing the quantitative findings.

3.6 Measures

We conducted a post-assessment to measure participants' user engagement using the User Engagement Scale and their responses to a cultural interest questionnaire. Interaction log data were also collected during the VR experiment, including gameplay duration, conversation logs with Onini, and walking distance.

The User Engagement Scale Long Form (UES-LF) [65] was used to measure the dependent variables: **Focused Attention (FA)**, **Perceived Usability (PU)**, **Aesthetic Appeal (AE)**, and **Reward (RW)**. The scale consists of 30 items rated from 1 (not at all) to 5 (very much), with randomized questions and reverse coding applied to minimize response bias. Details of the UES-LF items used in this study are provided in Table 6 in the Appendix. The UES-LF was selected for its validated reliability across diverse digital contexts [7, 46, 57] and its ability to capture multiple dimensions of engagement, distinguishing it from tools focused solely on user satisfaction.

To evaluate the impact of personalization and medium differences on cultural interests, we conducted a pre-assessment to collect data on participants' cultural backgrounds and prior exposure to storytelling technologies, including familiarity with VR, as shown in Appendix Table 5. A self-designed cultural interest questionnaire, consisting of five Likert-scale questions rated from 1 (not at all interested) to 5 (very much interested), was used to measure changes in attitudes toward cultural learning and curiosity. The specific questions are presented in Table 7 in the Appendix. This approach aligns with prior research [21, 38, 107], which highlights the importance of assessing cultural impact on user knowledge, emotional engagement, and connection to content.

3.7 Analysis

3.7.1 Quantitative Data. Statistical analyses were conducted using Python 3.12.5 [71]. Due to violations of normality and homogeneity of variance, the Kruskal-Wallis test was applied to both UES and Cultural Interest scores, with significant findings leading to post-hoc Mann-Whitney U tests adjusted using Bonferroni corrections. For Cultural Interest scores, the Holm-Bonferroni method, a less conservative alternative, was used to account for multiple comparisons. To further explore the relationships between user engagement and cultural interest, ordinal logistic regression (OLR) analysis was conducted. The Brant test was employed to assess the proportional odds assumption [10], with results indicating no significant violations ($p > 0.05$), confirming the suitability of OLR for this dataset. Odds ratios, along with confidence intervals, were reported to quantify the effects of UES scores on various cultural interest outcomes.

3.7.2 Qualitative Data. Qualitative data from the interviews were recorded, transcribed, and analyzed thematically following the methodologies of Braun and Clarke [12] and Campbell et al. [14], resulting in the thematic map shown in Figure 7. To ensure reliability, Cohen's kappa was calculated for inter-rater reliability between two coders who categorized 269 items into six categories: Immersion, Personalization, Engagement, Reflection, Culture, and Technological Intervention. The kappa score of 0.72, indicating substantial agreement (0.61 to 0.80) as per Viera and Garrett [100] and Eagan et al. [22], supports the consistency and validity of the coding process. Additionally, acknowledging the cultural-technical context of 'Anansi the Spider VR,' a positionality statement addressing the author's race, ethnicity, and potential affinities is provided in Appendix B. This mixed-method approach offered a comprehensive understanding of the relationship between user engagement and the personalized, immersive environments explored in this study.

Table 2: Summary of Participant Demographics from Semi-Structured Interviews.

ID	Gender	Age	Cultural Background	VR Experience	Occupation
VP1	Female	26	Indian	Moderately familiar	Accountant
VP2	Female	23	Turkish	Very familiar	EdTech Researcher
VP3	Male	25	Indian	Slightly familiar	Network Planner
VP4	Female	28	Peruvian	Slightly familiar	Consultant
VP5	Female	29	Uzbek	Moderately familiar	Manager
VP6	Male	24	Chinese	Very familiar	VR Engineer
VP7	Female	25	Romanian	Slightly familiar	Software Engineer
VP8	Female	23	Indian, German	Slightly familiar	Sustainability Consultant
VP9	Male	26	Brazilian, German	Slightly familiar	Electrical Engineer
VP10	Male	26	Ghanaian, German	Moderately familiar	Business Developer
VNP1	Male	22	Russian	Very familiar	Entrepreneur
VNP2	Male	35	Kenyan	Very familiar	Manager
VNP3	Female	25	Turkish	Moderately familiar	Kindergarten Teacher
VNP4	Male	24	Vietnamese, American	Moderately familiar	ML Engineer
VNP5	Male	27	Indian	Very familiar	Aerospace Engineer
VNP6	Female	24	Peruvian	Moderately familiar	Student
NVP1	Male	31	Indian	Moderately familiar	Product Manager
NVP2	Female	25	Uzbek	Moderately familiar	Student
NVNP1	Male	28	Indian	Very familiar	Manager
NVNP2	Female	24	Italian, German	Slightly familiar	Student

4 Results

The following sections detail the findings from both the quantitative analysis and the qualitative thematic analysis to comprehensively explore how Gen-AI and VR can enrich cultural storytelling.

4.1 User Engagement Scale (UES-LF) and Participant Interview

Our quantitative analysis used the User Engagement Scale Long Form (UES-LF) [65] to evaluate four dimensions of engagement: Focused Attention (FA), Perceived Usability (PU), Aesthetic Appeal (AE), and Reward (RW).

Figure 5 shows significant differences in UES scores across conditions ($X^2 = 298.59$, $p < .001$). Post-hoc analyses with Mann-Whitney U tests and Bonferroni corrections highlighted the benefits of personalization, particularly in non-VR settings. Both VR conditions (VP and VNP) outperformed non-VR conditions in FA, AE, and RW ($p < .001$). For example, in FA, VP ($M = 3.98$, $SD = 0.96$) and VNP ($M = 4.05$, $SD = 1.04$) scored significantly higher than NVNP ($M = 2.46$, $SD = 1.26$). Similarly, in AE, VP ($M = 4.23$, $SD = 0.91$) and VNP ($M = 4.40$, $SD = 0.64$) outperformed NVNP ($M = 2.52$, $SD = 1.38$).

In the PU dimension, both VR conditions showed significant advantages. VP ($M = 3.80$, $SD = 1.03$) and VNP ($M = 3.93$, $SD = 1.17$) outperformed NVNP ($M = 3.02$, $SD = 1.35$; $p = .0013$, $U = 3094$; $p < .001$, $U = 2838$, respectively). Interestingly, NVP ($M = 3.75$, $SD = 1.27$) also scored higher than NVNP ($p = .0041$, $U = 3196$), though it did not differ significantly from VNP ($p = 1.00$, $U = 4244$). These results suggest that VR enhances usability and personalization may amplify these effects.

In VR settings, qualitative feedback from semi-structured interviews revealed the impact of personalization, which was not fully captured by quantitative results. Participants in VP and VNP conditions provided contrasting experiences. Participant VNP1 remarked, "I would like it more if I was the real character." In contrast, participant VP1 stated, "Having the name makes you feel like you are really a part and more absorbed into the storytelling experience." Personalized NPC narration also reduced confusion during gameplay. Participant VNP2 noted, "I wish the NPCs were more personalized to guide me when I was stuck." Meanwhile, participant VP2 observed, "If the narrator didn't say my name, I might have been confused about whether it was talking to me." These insights demonstrate that personalization can be perceived within VR experiences and seamlessly integrated into the narrative.

4.2 Cultural Interest

A Cultural Interest Survey was developed to assess differences in cultural engagement, changes in interest, and the applicability of the system to other traditional folklore across different countries.

Figure 6 presents the Kruskal-Wallis test revealed significant differences in the scores of five individual cultural interest questions across the conditions ($X^2 = 52.34$, $p < .001$). Subsequent post-hoc pairwise comparisons, conducted using the Mann-Whitney U test with Benjamini-Hochberg correction for multiple testing, are depicted in Figure 6. The results indicated consistent superior performance by VR conditions.

For *"Interest in Ghanaian Culture,"* significant differences were observed between VP ($M = 4.08$, $SD = 0.79$) and NVNP ($M = 2.67$, $SD = 1.37$, $p = .013$, $U = 29.5$), and between VNP ($M = 4.08$, $SD = 0.79$) and NVNP ($p = .013$, $U = 29.5$). No other significant differences were noted in this category.

For *"Relevance of Anansi Story,"* VP ($M = 4.58$, $SD = 0.51$) demonstrated stronger significance compared to NVNP ($M = 3.17$,

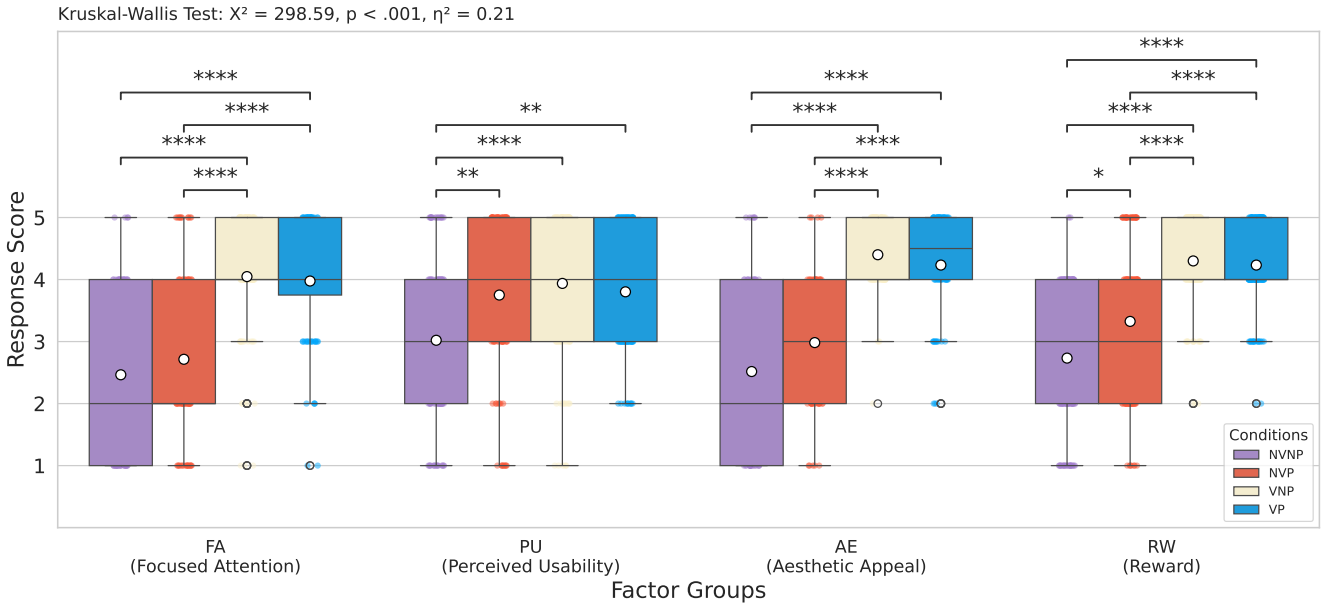


Figure 5: User Engagement Scores Across Different Experimental Conditions (NVNP, NVP, VNP, and VP). Each Factor Group represents a set of related items, with details available in Appendix Table 6. Responses were rated on a Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Significance levels are indicated by *, **, *, and ****, corresponding to $p < .05$, $p < .01$, $p < .001$, and $p < .0001$, respectively.**

$SD = 1.34$, $p = .004$, $U = 24.5$) than VNP ($M = 4.42$, $SD = 0.67$, $p = .013$, $U = 30.5$).

For *"Interest in African Folklore,"* both VP ($M = 3.83$, $SD = 0.94$) and VNP ($M = 3.83$, $SD = 1.19$) were significantly higher than NVNP ($M = 2.42$, $SD = 1.08$, $p = .005$, $U = 24.5$ for VP and $p = .008$, $U = 26.5$ for VNP).

In the category of *"Interest in Other Anansi Characters,"* VP ($M = 4.50$, $SD = 0.67$) was significantly higher than NVNP ($M = 3.00$, $SD = 1.48$, $p = .008$, $U = 27.5$).

For *"Interest in Exploring Other Folklore,"* significant differences were found for VP ($M = 4.83$, $SD = 0.39$) compared to NVNP ($M = 2.92$, $SD = 1.51$, $p = .002$, $U = 22.0$), and VNP ($M = 4.50$, $SD = 0.80$) compared to NVNP ($p = .009$, $U = 29.0$).

No significant differences were found between VP and VNP or between NVP and NVNP, indicating that personalization within VR or non-VR mediums did not significantly impact cultural interest metrics in this study.

The qualitative insights further highlight these findings, illustrating how personalization makes cultural narratives more relatable for individuals from diverse backgrounds. Participant VP6 commented, "I think African stories are very far away from me. But this game made them so close to me. So I was more interested, even though I am not usually." This statement highlights the potential of using personalized narratives in VR to bridge cultural gaps and enhance engagement. Similarly, Participant NVP2 reflected, "After the story, I thought to myself: Wow, there are many things about Africa I need to learn about. I will also tell my niece and nephew about this story," underscoring the potential of personalized content to extend cultural exchange beyond the virtual experience.

4.3 The Relationship Between UES and Cultural Interest

An Ordinal Logistic Regression (OLR) analysis was conducted to examine the relationship between total User Engagement Scale (UES) scores and various cultural interest outcomes. Results, presented in Table 3, show that higher UES scores significantly predicted greater cultural interest across all measures. For **interest in Ghanaian culture**, a one-unit increase in UES score increased the odds by approximately eight times (OR = 7.78, $p < 0.001$). Similarly, higher UES scores were associated with a 5-fold increase in the likelihood of finding the **Anansi story relevant** (OR = 4.88, $p = 0.001$). **Interest in African folklore** was strongly predicted by UES scores (OR = 10.15, $p < 0.001$), as was **interest in other Anansi characters** (OR = 13.98, $p < 0.001$). Finally, engagement scores also significantly predicted a nearly 20-fold increase in **interest in exploring other folklore** (OR = 19.96, $p < 0.001$).

4.4 Qualitative Findings

Based on thematic analysis, six key themes emerged: **Immersion**, **Personalization**, **Engagement**, **Reflection**, **Cultural Relevance**, and **Technological Intervention**. These themes delineate how VR and Gen-AI influenced participants' experiences, providing insights into how immersion and personalization shaped their engagement and understanding of oral storytelling through the Anansi the Spider VR experience. Detailed descriptions of the key themes and subthemes identified are provided in Appendix Tables 10, 11, 12, 13, 14, and 15.

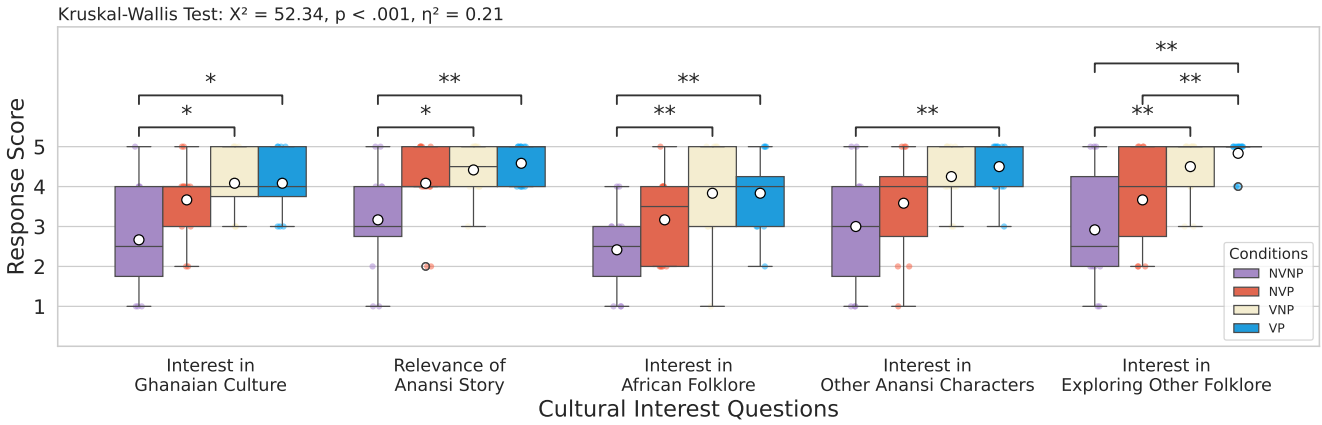


Figure 6: Interest Scores Across Different Experimental Conditions in African Folklore and Cultural Learning (NVNP, NVP, VNP, and VP). See Appendix Table 7 for a summary of the Cultural Interest Questionnaire items and the Likert scale used. Responses were rated on a Likert scale from 1 (Not Interested at All) to 5 (Very Interested). Significance levels are indicated by *, **, *, and ****, corresponding to $p < .05$, $p < .01$, $p < .001$, and $p < .0001$, respectively.**

Table 3: Results of the Ordinal Logistic Regression analysis with Total UES Score as the predictor for different cultural interest outcomes.

Model Summary Predictor: Total UES Score					n = 48
	Estimate	Std. Error	t-value	p-value	Odds Ratio (95% CI)
Interest in Ghanaian Culture	2.051	0.478	4.293	<0.001	7.78 (2.46, 24.57)
Relevance of Anansi Story	1.586	0.464	3.420	0.001	4.88 (1.94, 12.27)
Interest in African Folklore	2.317	0.500	4.638	<0.001	10.15 (3.63, 28.36)
Interest in Other Anansi Characters	2.639	0.558	4.727	<0.001	13.98 (4.50, 43.42)
Interest in Exploring Other Folklore	2.996	0.625	4.795	<0.001	19.96 (5.36, 74.35)

4.4.1 Immersion. Participants highlighted how VR created a vivid and lifelike environment, enhancing their sense of presence. VNP5 remarked, "I just lost track of time and completely felt the surroundings. Like, I was completely immersed in the jungle." Similarly, VP1 shared, "When I had to walk through and there were trees, I was bending my head because I felt like they were going to hit me."

The physical sensations of VR also reinforced this realism. VNP3 described, "When I was on top of the mountain, I actually felt a strange, tickling feeling on my feet." Emotional responses, such as fear and anxiety, further anchored participants in the narrative.

4.4.2 Personalization. Personalization strengthened participants' connection to the story by tailoring interactions to their identities. VP4 shared, "Hearing my name during the experience made it feel as though it was designed just for me." VP5 noted, "It pronounced my name correctly, which made the story feel personal and gave me a sense of being the main character." VP6's experience underscored the familiarity dimension of personalization, stating, "It felt like I was chatting with my friends or someone who really knows me."

In contrast, non-personalized conditions resulted in detachment. VNP2 explained, "I wish the NPCs were more personalized. They would be much more relevant if they could guide me when I'm stuck." NVNP1 remarked, "I don't find the story engaging, there are also many strange names of the characters that I have never come across before."

4.4.3 Engagement. Participants identified interactivity, active agency, and aesthetic appeal as pivotal factors enhancing their engagement in the Anansi the Spider VR experience.

> "Games and stories are typically set in stone once told. However, VR experiences are valuable because they showcase how different choices can lead to varied outcomes, illustrating the real-life impact of our decisions." (VP10)

VP4 shared that the interactive nature of the experience made them feel more engaged: "The interaction made me feel more engaged, I was so curious I wished I could interact with everything, though it wasn't possible... I wanted to explore every part of the world."

Aesthetic appeal also contributed to engagement. VP5 remarked, "The music and sounds were captivating, the sound of the waterfall felt incredibly real, enhancing my enjoyment." Similarly, VP1 noted, The visuals were engaging and appealing. "From the beginning,

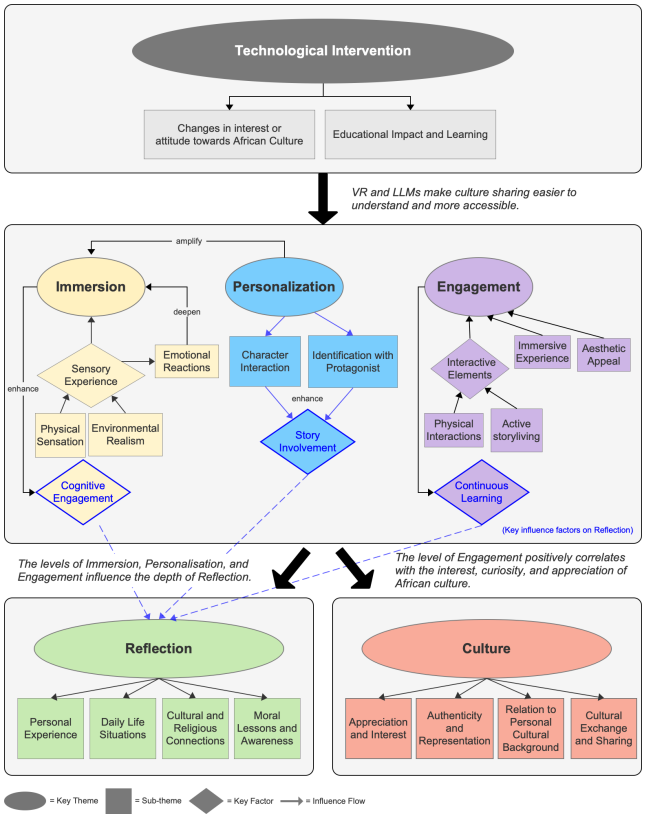


Figure 7: The Role of VR and Gen-AI in Enhancing Understanding and Appreciation of African Culture: This thematic map illustrates how VR and Gen-AI influence immersion, personalization, and engagement, deepening reflection and fostering appreciation, while enriching understanding and interest in African culture.

it felt like you were really there. The trees and mountains were somewhat intimidating, adding to the interactivity."

Participants also described the experience as requiring less effort to stay engaged compared to traditional storytelling formats. As VP4 explained, "Engaging with VR required less effort compared to traditional oral storytelling or watching a movie, and my interest grew much more easily."

The combination of interactivity and aesthetic appeal supported participants' engagement, offering a dynamic alternative to traditional storytelling formats.

4.4.4 Reflection. Participants connected the story's themes to their own lives, drawing parallels between the narrative and personal experiences. These reflections are categorized into four areas: personal experience, daily life situations, cultural and religious connections, and moral lessons and awareness, as shown in Figure 8.

Participants in the VP condition frequently described a stronger sense of involvement due to personalized interactions. For example, VP7 shared, "The story reminds me of recent job-seeking efforts where I personalized applications only for positions I truly wanted and mass-sent the others." Similarly, VP5 reflected, "You have to think before acting, and you have to make smart moves. The snake is very strong, but you can be stronger with your intelligence."

In the VNP condition, participants also reflected on similar themes but often described them in broader terms. VNP2 remarked, "As a university student in a foreign culture, this story reinforced the importance of relying on intelligence over brute strength, emphasizing its enduring moral relevance." VNP3 added, "After a tough day at work with hierarchical challenges, tonight's VR experience was enlightening. It showed me that strength does not matter if you have a good strategy."

Cultural and religious reflections also varied between conditions. In the VP condition, some participants tied the narrative to their family traditions or personal beliefs. For instance, VP4 noted, "Coming from a Catholic background, it reminded me of David and Goliath. My grandfather used to tell it to me like a fairy tale." Participants in the VNP condition shared broader cultural connections. VNP6 explained, "My family used to tell me stories, and they come from different cities, so they would tell me stories and show me pictures." These reflections illustrate how participants in different conditions connected the story's themes to their own lives.

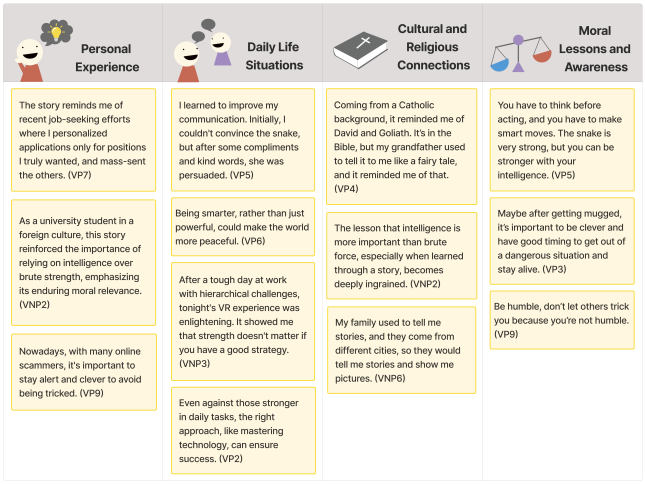


Figure 8: Table of participant reflections categorized by themes: Personal Experience, Daily Life Situations, Cultural and Religious Connections, and Moral Lessons and Awareness. Each category is accompanied by relevant quotes from participants, illustrating the impact of VR and personalization on their perception and engagement with the narrative.

4.4.5 Cultural Relevance. Participants highlighted how the immersive storytelling experience deepened their understanding of African folklore and oral traditions, making them more relatable. VNP5 remarked, "I appreciate all cultures and find it fascinating to see how different cultures differ in so many activities but share common values of life. It was nice to learn the characters that were represented, like the sky god and the spider." Similarly, VNP3 noted similarities with their own heritage, stating, "About African culture: I learned that animals represent some emotions and authority figures, and want to share a moral through animal figures. It is also like this in my culture, Turkish culture, because animals were there

before humans. They use animals to explain something bigger in the story."

The experience also prompted reflections on the broader significance of oral storytelling. VP8 shared, "Growing up, every time my family members would say a word which we don't know, they always had a story behind it, so they have to tell us a story to show us what it actually means and why it's still relevant today."

4.4.6 Technological Intervention. Participants appreciated how VR and AI made cultural narratives engaging and accessible. VNP6 shared, "This was more interesting than previous VR experiences because I was learning about a new culture." VP8 highlighted how these technologies appeal to younger, digitally savvy audiences, noting, "The generation right now and the generation which is coming would be more interested in AI and VR because they are already playing games, have mobile phones, etc. It is a way to make them understand their culture."

Participants also valued how these technologies foster understanding and appreciation for other traditions. VP5 emphasized their ability to simulate cultural experiences, making them more relatable. However, VP10 expressed concerns about losing the communal essence of oral storytelling, noting, "Wish the story had started with like a group setting, to then maybe seeing someone that could be my mother... Which story would you like to hear today?"

These insights highlight how VR and AI together create immersive and meaningful storytelling experiences, while also revealing opportunities to preserve traditional communal aspects.

5 Discussion

In this study, we explored the impact of Gen-AI personalization and VR immersion on oral storytelling through a mixed-method user study ($n = 48$), focusing on user engagement and cultural learning. We discuss the results in three directions, examining the individual impacts of VR and Gen-AI, their combined role in rekindling cultural heritage interest, and providing design recommendations to balance authenticity with innovation.

5.1 Impact of Personalization

Addressing **RQ1**, our findings reveal that personalization significantly enhanced user engagement in non-VR conditions, as evidenced by higher PU and RW scores in personalized settings. Qualitative feedback suggests that the integration of personalization, such as name recognition, not only fostered a stronger sense of agency and emotional connection but also added a sense of narrative familiarity as if shared by a close friend. This aligns with prior research showing that correct name pronunciation can enhance users' perceptions and engagement, demonstrating the role of personalization in deepening user-agent connections [37].

In contrast, non-personalized conditions were often associated with confusion and detachment. However, the subtler impact of personalization in VR conditions may reflect the overshadowing effect of VR's sensory immersion, as highlighted in prior studies [23, 52]. This underscores the need to optimize personalization in immersive contexts, ensuring it complements rather than competes with VR's immersive qualities. Additionally, while latency (2–7 seconds) for AI-driven responses was within acceptable ranges for real-time interactions, participants did not perceive this as a hindrance to immersion or flow. Future iterations could focus on further reducing response times to enhance fluidity and maintain seamless storytelling experiences. These findings suggest that personalization can modernize traditional narratives, making them more relatable and engaging for younger audiences.

5.2 Role of VR Immersion

Addressing **RQ2**, VR consistently outperformed non-VR conditions across all engagement dimensions (FA, AE, RW) and cultural interest measures, including interest in exploring other folklore and the relevance of the Anansi story. These findings highlight VR's ability to evoke curiosity and appreciation for cultural narratives.

Qualitative insights supported these results, with participants noting how VR's sensory and interactive elements transformed traditional storytelling. They emphasized lifelike environments and decision-making opportunities as key factors in creating a dynamic connection to the story. These findings align with prior research on VR's capacity to enhance emotional engagement and cultural learning [68, 90, 106].

For oral storytelling, VR provides a unique medium to bridge generational and cultural gaps by presenting traditional narratives in formats that resonate with digital-native audiences. The combination of immersive environments and interactive storytelling holds significant potential for modernizing oral traditions.

5.3 Gen-AI and VR for Oral Storytelling Understanding and Preservation

Our findings demonstrate the potential of VR immersion and Gen-AI personalization in supporting the understanding and transmission of oral storytelling traditions. We answer **RQ3** by (1) fostering connections to oral storytelling traditions and (2) revitalizing these narratives in the digital era to engage younger audiences.

5.3.1 Connection to Oral Storytelling. The integration of VR immersion and Gen-AI personalization bridges cultural gaps, fostering deeper connections and reflections on traditional oral storytelling. Traditional narratives often struggle to resonate with diverse audiences due to their detachment from individual cultural contexts [6]. Our findings demonstrate that AI-powered personalization, through features like name recognition and adaptive dialogue, helps make these stories more inclusive and relatable. Participants from diverse cultural backgrounds reported stronger connections to the narratives, effectively addressing this critique.

Participants reflected on how these tales resonated with their personal experiences and daily lives, as illustrated in Figure 8. Gen-AI personalization complemented VR by immersing participants in the story's moral and cultural dimensions, transforming them from passive listeners into active contributors. Notably, Anansi's role in the experience shifted from the original tale's storyteller to a facilitated narrative guide, with participants becoming the ones who collected these tales. This change allowed participants to envision themselves as the "Hero of the Day," aligning with research on "storification," which emphasizes how first-person engagement deepens emotional resonance, responsibility, and cultural understanding [4, 42].

While this narrative shift enhances user engagement and relatability, it raises important questions about preserving the authenticity of the original folklore. Balancing such interactivity with cultural integrity is critical and is further explored in the design recommendations section.

5.3.2 Revitalizing Oral Storytelling in the Digital Era. Our findings illustrate how VR and Gen-AI foster shared cultural understanding for younger audiences. While VR emphasizes individual immersion, participants expressed a strong desire to share the Anansi tale with family members, highlighting storytelling's intergenerational role in cultural transmission. Gen-AI enhances this by tailoring narratives to participants' identities, fostering cross-cultural appreciation through shared symbols like animal metaphors, as mentioned during interviews.

For participants from immigrant backgrounds, such as VP10, a second-generation Ghanaian living in Germany, these technologies offered a powerful reconnection with cultural roots. VP10 reflected on their limited exposure to cultural narratives growing up and emphasized the importance of incorporating communal elements into immersive storytelling. They envisioned features like multiplayer modes and group settings to evoke the shared atmosphere of traditional storytelling:

> "It would be better if there were multiplayer scenes where we can be together, like a co-op experience." (VP10)

These insights highlight the potential of VR and Gen-AI to preserve and adapt oral storytelling for younger, digitally native audiences. Traditional oral storytelling methods often struggle to engage second-generation individuals disconnected from their heritage or audiences from other cultural backgrounds unfamiliar with these narratives. VR offers vivid, immediate access to historically and culturally rich stories, while personalized AI provides context, making these tales more relatable to diverse cultural audiences. Together, these technologies address the challenge of making traditional narratives resonate with modern users by bridging gaps in understanding and adapting cultural stories for younger audiences.

VP10 also articulated the long-term potential of these technologies for integrating traditional storytelling into future familial practices:

> "Unfortunately, I did not have as much cultural transmission as I would have loved to have had, which I am trying to make up by reading books, etc., about my own culture. But probably, definitely, for me in the future, these stories are going to be a core part for my family." (VP10)

5.4 Design Recommendations for Cultural Preservation and Transmission

Combining our findings and prior literature, we propose two design recommendations for personalized VR interventions that balance cultural authenticity with fostering cultural reflection and transmission.

5.4.1 Maintain Story Authenticity in Interactive Narrative Structures. When designing immersive narratives based on oral traditions, it is crucial to balance innovation with preserving the core structure of the story. Modern audiences expect interactivity in VR experiences, but these elements should not distort the cultural meaning of the original narrative. In the 'Anansi the Spider VR' experience, participants appreciated the balance between personalization and staying true to the original narrative. VP4 commented, "I like when stories are like, you have A and B, and regardless of A or B, the outcome is the same," expressing a preference for choices that maintain the story's core outcome. Similarly, VP9 emphasized the importance of preserving the original tale, noting that while it is normal to make changes, it is crucial not to alter the story too much to ensure it can still be passed on in its authentic form.

The narrative model we used, referred to as a "yo-yo" structure [27], allowed participants to explore alternative branches while always returning to the main plot. This model preserves cohesion while enabling meaningful interaction. Future immersive storytelling approaches can adopt similar methods to maintain structural integrity while supporting user-driven interaction.

5.4.2 Align VR Experiences with Cultural Origins and Context. VR experiences should reflect the cultural context of oral traditions, which often emerge from communal settings like storytelling around a campfire. VP8 emphasized authenticity, suggesting that visuals should first depict how the story begins before transitioning into the narrative. Grounding users in these cultural and historical roots is crucial. Jones [33] research warns that VR's visual capabilities may bias storytelling, potentially overshadowing core messages. To counter this, stories must be carefully introduced and framed within culturally significant settings. Following UNESCO ICH guidelines [94], creators can collaborate with cultural custodians such as elders, historians, and storytellers to ensure environments, symbols, and narrative choices remain faithful to the tradition's narratives. Such collaboration helps maintain authenticity, acknowledges local expertise, and respects the intellectual property of source communities. While modern technology enables interactivity and personalization, designers must prioritize cultural integrity by preserving key moments, settings, and values that have long been transmitted through face-to-face interaction to ensure these immersive experiences stay true to their original context.

6 Limitations and Future Work

The discussion highlights key findings that help drive future research in oral storytelling. While this study has certain limitations, they are outlined below to guide more comprehensive evaluations in future work.

First, the quantitative results demonstrated limited sensitivity, with high UES scores in VR conditions suggesting a potential ceiling effect that may have masked subtle differences between personalized and non-personalized experiences. While semi-structured interviews provided richer insights, they lacked real-time data on participants' emotional and cognitive processes during the experience. Future research could address this by employing think-aloud methods during VR sessions [80], enabling participants to articulate their thoughts in real-time. Although these methods may disrupt immersion [103], guided reflections at key narrative moments could uncover hidden dynamics of VR and AI-enhanced storytelling, offering deeper insights into user experiences.

Second, the modest sample size ($n = 48$) and limited diversity of participants in terms of age range and educational backgrounds constrain the generalizability of the findings. While the statistical assumptions for OLR were met, the modest sample size and participant homogeneity require careful interpretation of the results, particularly when extrapolating to broader or more diverse populations. Furthermore, the limited sample size may reduce the power of the analysis to detect subtle effects. Although this study is exploratory and not intended for broad generalization, it offers valuable insights into how emerging technologies can enhance cultural engagement. Future studies could address these limitations by recruiting larger, more diverse participant pools, potentially through partnerships with public cultural institutions. Such efforts would improve inclusivity, strengthen the validity of the findings, and help determine the extent to which these approaches may be adapted for different cultural contexts.

Third, the individual-focused nature of VR and Gen-AI in this study diverges from the communal essence of traditional oral storytelling. Participants, such as VP10 and VP8, highlighted the importance of incorporating group settings like storytelling around a campfire to better reflect the shared atmosphere of oral traditions. While this research did not directly involve cultural custodians or local communities in the design process, future work will prioritize collaboration with these stakeholders to ensure authenticity and respect for the cultural origins of these narratives. By aligning closely with traditional practices and exploring co-op storytelling experiences, future research can foster shared cultural connections across generations and diverse backgrounds, addressing both ethical considerations and the richness of communal storytelling traditions.

Finally, as emphasized by Otero-Pailos [64], rethinking heritage conservation methods is critical. Collaborations with museums and cultural institutions could position VR and Gen-AI as participatory tools, transforming preservation from an expert-led to a community-driven process. This study, illustrated in Appendix Figure 9, demonstrates how digital storytelling fosters co-creation, allowing individuals to shape and reinterpret traditional tales, thereby promoting a collective cultural identity [53]. Future research could include longitudinal studies and participatory design approaches to assess whether these technologies can foster lasting cultural connections, influence behaviour, and facilitate intercultural dialogue when integrated into public cultural repositories [26, 38].

7 Conclusion

To investigate how VR immersion and Gen-AI-driven personalization can enhance storytelling, particularly in the context of preserving oral traditions, we developed 'Anansi the Spider VR', an innovative approach to revitalizing a Ghanaian oral tradition. Through a mixed-methods design with ($n = 48$) participants, we explored the impact of VR immersion and Gen-AI-driven personalization on engagement and cultural learning. Quantitative findings showed that both immersion and personalization significantly enhanced user engagement and interest in cultural learning.

Qualitative findings revealed that VR and Gen-AI can transform user participation in storytelling, fostering cultural transmission, bridging cultural distances, and promoting self-reflection. Participants not only connected with African folklore but also reflected on their own experiences through the lessons of the stories. These insights highlight the role of immersive technologies in preserving and revitalizing cultural narratives.

This study also identified challenges in quantifying personal experiences within VR, underscoring the limitations of standardized tools like the UES. Future research should focus on developing more nuanced measurement methods and collaborating with cultural institutions to further explore and preserve immersive storytelling experiences.

Overall, this research underscores the potential of VR and Gen-AI to maintain the relevance and impact of traditional tales in the digital age, ensuring that stories like Anansi continue to inspire and educate future generations. By bridging cultural gaps and fostering engagement through personalized and immersive technologies, this study provides a foundation for future initiatives aimed at preserving diverse oral traditions, promoting cultural understanding, and innovating heritage education on a global scale.

8 Open Science

The source code and assets for Anansi the Spider VR are available at the following link: https://gitlab.lrz.de/hctl/anansispidervr.

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A Participant Demographics

Table 4: Participant Demographics and Pre-Assessment Scores. Likert scale: 1 (Not at all Familiar) to 5 (Very Familiar). $n = 12$ per condition.

	NVNP		NVP		VNP		VP	
Metric	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Age	24.5	3.2	25.8	4.1	26.3	3.7	27.2	4.0
Gender Distribution (%)								
Female	52	-	47	-	53	-	48	-
Male	48	-	53	-	47	-	52	-
Storytelling Fam.	3.3	1.0	3.5	1.0	3.7	1.3	3.8	0.8
VR Familiarity	3.1	1.2	2.6	0.7	3.0	0.9	2.6	0.8
Oral Traditions Fam.	2.4	1.0	2.2	1.0	2.9	1.3	3.0	1.3
African Folklore Fam.	1.3	0.6	1.2	0.4	1.8	0.9	1.6	0.9
Interest in Cultures	3.6	1.2	4.2	0.6	4.0	0.6	3.8	0.9
Comfort with Personalization	3.8	1.0	3.8	0.9	3.3	1.1	3.8	0.8

B Researchers Positionality Statement

As the main researcher in this study, I acknowledge myself as an educated Asian researcher, my approach to studying and revitalizing folklore is informed by a background that blends academic diligence with a passion for cultural heritage. My work is driven by a commitment to understanding and preserving diverse narratives through technology. This position allows me to reinterpret folklore with a fresh perspective, aiming to make these traditional stories relevant and reachable to contemporary audiences. My values emphasize respect for cultural authenticity and the power of storytelling in bridging cultural divides.

C Pre-Assessment Questionnaire

Table 5: Pre-Assessment Questionnaire: Items and Response Options.

Question	Response Options
Cultural background (ethnicity, upbringing, media exposure)	Open-ended
Education level	High School, Bachelor's, Master's, Doctoral
Digital storytelling engagement (audiobooks, podcasts, interactive stories)	Never, Rarely, Sometimes, Often, Very Often
Familiarity with virtual reality	Not at all, Slightly, Moderately, Very, Extremely
Familiarity with oral traditions	Not at all, Slightly, Moderately, Very, Extremely
Familiarity with African folklore	Not at all, Slightly, Moderately, Very, Extremely
Interest in learning about other cultures	Not at all, Slightly, Moderately, Very, Extremely
Comfort with adaptive tech (personalized content)	Very Uncomfortable, Uncomfortable, Neutral, Comfortable, Very Comfortable
Preferred cultural learning methods	Books, Museums, Interactive, Films, Online, Travel, Conversations

D User Engagement Scale Long Form

Table 6: Summary of Factors and Items from UES-LF Questionnaire. Likert scale: 1 (Strongly Disagree) to 5 (Strongly Agree).

Factor	Item	Question
Focused Attention (FA)	FA.1	I felt immersed.
	FA.2	I was so involved I lost track of time.
	FA.3	I ignored things around me.
	FA.4	I lost awareness of my surroundings.
	FA.5	Time passed quickly.
	FA.6	I was fully absorbed.
	FA.7	I let myself go.
Perceived Usability (PU)	PU.1	I felt frustrated.
	PU.2	I found it confusing.
	PU.3	I felt annoyed.
	PU.4	I felt discouraged.
	PU.5	Using this was tiring.
	PU.6	The experience was demanding.
	PU.7	I felt in control.
	PU.8	I couldn't do some tasks.
Aesthetic Appeal (AE)	AE.1	The experience was visually appealing.
	AE.2	It was aesthetically pleasing.
	AE.3	I liked the graphics.
	AE.4	The visuals were engaging.
	AE.5	The screen layout looked good.
Rewarding (RW)	RW.1	The experience was valuable.
	RW.2	I consider it successful.
	RW.3	It didn't work as expected.
	RW.4	My experience was rewarding.
	RW.5	I would recommend it.
	RW.6	I would use it again.
	RW.7	It sparked my curiosity.
	RW.8	I was drawn into it.
	RW.9	I felt engaged.
	RW.10	The experience was fun.

E Cultural Interest Questionnaire

Table 7: Summary of Cultural Interest Questionnaire Items and Likert Scale.

Questions	Likert Scale (1-5)
How interested are you in learning more about Ghanaian culture after reading the Anansi story?	Not interested at all to Very interested
How relevant do you think the moral lessons from the Anansi story are to modern life?	Not relevant at all to Very relevant
How likely are you to seek out more African folklore after reading the Anansi story?	Not interested at all to Very interested
Anansi stories feature other interesting characters, such as Tiger, Turtle, and Monkey. How interested are you in learning about these characters and their stories?	Not interested at all to Very interested
After the user study, would you be interested in using the same system to learn about oral traditions from other cultures, such as Grimm's Fairy Tales?	Not interested at all to Very interested

F User-generated Narrations

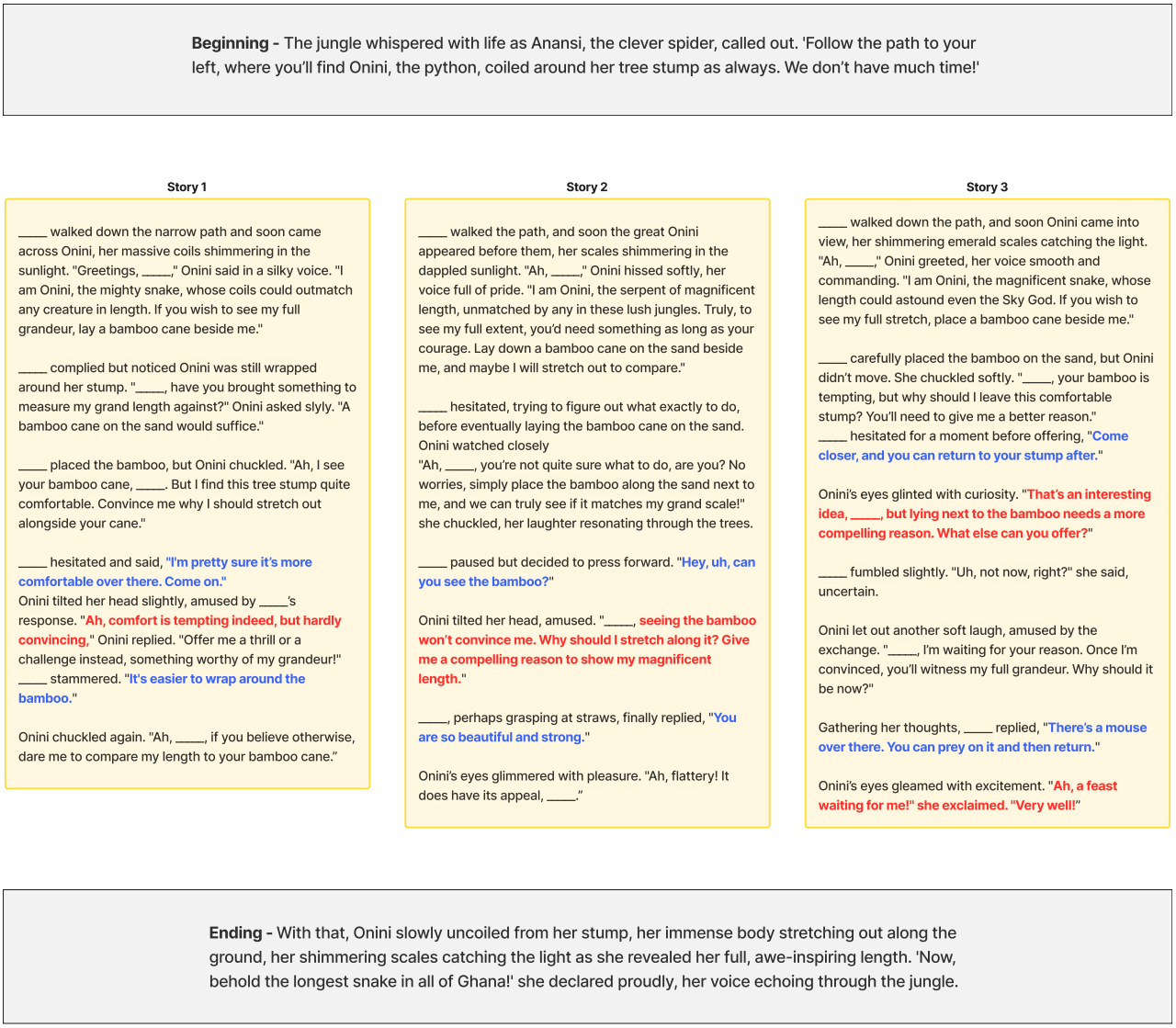

Figure 9: Figure illustrates three user-generated stories in Anansi the Spider VR. Blue denotes user inputs via speech-to-text, actively shaping the tale, while red illustrates AI-generated responses via text-to-speech, demonstrating the dynamic interplay between participant choices and Gen-AI storytelling.

G Thematic Tables

Themes	Quotes	Sub-themes
A - Immersion: Participants felt physically present in the virtual environment, with sensory and emotional stimuli deepening their immersive experience.	**Environmental Realism** • At some moments, I was like, **grab me, I'm going to fall**. I was feeling like I was really in a space, but no one was around me, and I was just going through the story. (VP8) • I felt like I was **part of a different world, a virtual world**. (VNP2) • The biggest compliment would be that **I just lost track of time** and also completely felt the surroundings. Like, I was completely **immersed in the jungle**. (VNP5) • Sometimes **I forgot that I was in the room, and I hit the table** because I thought the controller could go through. (VNP1)	**A1 - Sensory Experience:** The sensory inputs, such as sight and sound, play a crucial role in enhancing the immersiveness of the VR experience. This heightened immersion often leads to participants experiencing physical sensations, such as tickling or the fear of hitting objects, as their senses respond to the virtual environment.
	Physical Sensation • When I was on top of the mountain, I actually **felt a strange, tickling feeling on my feet**. (VNP3) • When I had to walk through and there were trees, I was **bending my head** because I felt like **they were going to hit me**. (VP1)	
	• It was really realistic, there were times when it was **really scary**, so I focused on every part. It was nice to explore and try different strategies. (VNP6) • **It felt real**. You weren't using your legs, though, but moving. I saw these animals, and I felt a bit scared. (VP5) • Sometimes the visuals felt too real and scary, and I felt like I was **really in danger** or was going to fall. (VP8) • It felt **weirdly real** to the point where I got a bit **uncomfortable** when I got to a height—I am **scared of heights**. (VP10)	**A2 - Emotional Reactions:** Emotional responses like realism, fear, and anxiety are intensified by the VR environment, making the experience more engaging and memorable. This emotional depth enhances the overall immersion.
	• The gods were very detailed and they looked very nice, so it really **imprinted in my memory how they looked**. (VP9) • Compared to other mediums, I think this aspect **blocks other stimuli in the background so you really focus on the story**. If I was reading, I will have a lot of distractions around me or if I was watching something on a laptop, but this forces you to fully focus on the environment and it also has the element of view interacting with the environment, so it makes it feel **more tangible and real**. (VNP2)	**A3 - Cognitive Engagement:** The VR experience enhances focus by immersing participants in detailed visuals and narrative, reducing distractions and making the experience feel more tangible and real.

Figure 10: Thematic analysis results: Immersion.

B - Personalization: The experience tailored story elements to individual users, such as including their names and offering choices, which increased their connection to and immersion in the narrative.	• Having to walk through different environments and **maneuvering and taking actions made me feel like I was the center of the story**. (VNP2) • I thought it was really interesting because I really felt that I **had to participate** in the story, and this contributed to my **interest and attention**. (VNP6) • The aspect that stood out to me the most was that it was personalized to my name. It felt like **I was playing a character in a way that I was involved in the story**. (NVP1) • I feel like the fact that the story calling out my name, **makes me feel like I am needed** and I would like to keep going in the story. (VP7) • The first time [I heard my name] I was like, oh they know my name, and they're **pronouncing it well**, so I was like wow. (VP4) • The experience made me feel **almost like a real character**. It felt like I was **chatting with my friends** or someone who really knows me. (VP6) • It felt like **it was talking to me**, which was pretty nice, felt more direct or **personalized than general life stories that can be shared across the board.** (VP10)	**B1 - Story Involvement:** Personalisation made participants feel more central to the narrative, enhancing their sense of involvement by directly incorporating their names and choices into the story, making them feel like active participants rather than passive observers.
	• It feels like **I am the main hero** helping Anansi. (NVP2) • I am open to embracing any medium that brings the user, or the hero of the story, **closer to the reality of the narrative**. (VNP2) • It felt like a personalized touch, like I am **one of the main characters** and I was **playing a role** and I felt like I'm doing something great. (VP5) • Hearing my name fascinated me. **When you see a movie, and say a character's name, it was just like that, saying my name**. (VP8)	**B2 - Identification with Protagonist:** Through personalisation, participants identified themselves as the main character or hero of the story, increasing their connection and emotional investment in the narrative.
	• The **character was speaking to me, not just going on telling a story, and gave me tasks**, and I think the **personalization was great without changing the story too much**. (VP3) • The **method I used to catch the snake because it was kind of smart**, but I convinced it by saying I will bring it to a safer place and trick it. **I felt good, my method was intelligence and also resourceful so I got the moral message too.** (VP8) • **I felt wise tricking the snake** and it was **rewarding** to hear you did a good job. (VP5)	**B3 - Character Interaction:** Personalisation enhanced interactions with story characters, making these exchanges feel more meaningful and tailored, thereby enriching the overall narrative experience.

Figure 11: Thematic analysis results: Personalization.

C - Engagement: Participants were consistently involved in the experience.	**Physical Interactions** • The story was organized in a way that constantly asked you to do something, like move to a place or grab something, **which kept you engaged and on your toes.** (VNP5) • It was **nice to move our hands and literally be there**, instead of just looking at a screen. (VNP1) • The movement in the virtual world around me, **turning in the real world and seeing the virtual world** also increase my engagement. (VP3) • The **interactivity was what made it so engaging and immersive**. (VP3)	**C1 - Interactive Elements:** Physical movement and task-oriented activities within the VR environment enhance participant engagement by making them active participants in the story.
	• The **moral of the story could have impacted me more if I was more involved.** (NVNP2) • It was like **feeling like the main character, the story would be more engraved** in my mind. (NVNP2) • The **waterfall and nature sounds**, that is when VR and AR is really helpful to take you out of the room. (VNP2) • **VR will take my attention or motivation quickly**, listening to the story in the classroom settings but in VR is different because **there is more context inside the story.** (VP2) • Compared to **oral storytelling or watching a movie, the effort it takes to get engaged was less in VR**, and **my interest grew much easier.** (VP8)	**C2 - Immersive Experience:** The immersive nature of VR, characterized by a strong sense of presence and the feeling of being the main character, makes the experience more contextual and engaging.
	• This was the **most beautiful VR experience I have ever had.** (VNP3) • The **graphics were amazing**, it really got me into the game. (VP4) • I think this was my best experience in VR. **It felt super real, graphic scene, unlike lots of games have too many shapes, polygons, but this felt real.** (VP6) • I learned a story, I learned about a culture today. **Because of the illustrations, I lived it.** I experienced it but I also lived it, **so I call this learning, learning is to live it.** (VNP3)	**C3 - Aesthetic Appeal:** The visual quality of the VR environment captures participants' attention, contributing to an engaging experience.
	• I think **this story will stay with me for a lifetime.** Because stories that I heard when I was younger, **I forget the details, but here, I was experiencing it. I felt, in the moment, and you can never forget what you feel physically, and the memory captures moments better than just listening.** (VP5) • After this, **I am going to Google more about the Anansi story because I want to know more.** (VP4)	**C4 - Continuous Learning:** The continuous flow of the VR experience sustains participants' interest, leading to ongoing engagement both during and after the activity.

Figure 12: Thematic analysis results: Engagement.

D - Reflection: Participants deeply reflected on the personal and cultural implications of the story, applying its lessons to their own lives.	• The story reminds me of **recent situations where I have been working on a bunch of job-seeking applications**. Instead of personalizing each one, I decided to personalize only the positions I am truly aiming for and mass-send the rest. (VP7) • As a university student, this reminded me a lot about being a good student, being intelligent. And **being in a foreign culture, you sort of think of the many times where you had to rely on your intelligence rather than just brute strength**. I think the story passes on this good moral message. I think the moral of the story is still very, very relevant. (VNP2)	**D1 - Reflections on Personal Experience:** Participants related the story to their own life experiences, such as job-seeking and navigating foreign cultures, emphasizing the relevance of the story's lessons in their personal lives.
	• Maybe after getting mugged, it's important to **be clever and have good timing to get out of a dangerous situation** and stay alive. (VP3) • You have to **think before acting, and you have to make smart moves**. The snake is very strong, but you can be stronger with your intelligence. (VP5) • There are also people who are strong and can do everything in daily life, but if you use the correct path, you can do everything you want. **For example, knowing how to use technology can make you win**. (VP2) • Something I can take from this experience would be I could be better at communicating because, you know, on the first try, I could not convince the snake to do what I wanted her to do, but I complimented and said some nice words, and it convinced her. (VP5) • Instead of just power, being smarter might make the world much more peaceful. (VP6) • It made me think about how you have to **be patient**. (VNP6) • Smart work is better than hard work. (NVNP1)	**D2 - Reflections on Daily Life Situations:** Participants drew parallels between the story and everyday challenges, such as communication, patience, and strategic thinking, recognizing the story's applicability to common life scenarios.
	• Coming from a **Catholic background, it reminded me of David and Goliath**. It's in the Bible, but my grandfather used to tell it to me like a fairy tale, and it reminded me of that. (VP4) • My family used to tell me stories, and they come from different cities, so they would tell me stories and show me pictures. (VNP6)	**D3 - Reflection on Cultural and Religious Connections:** Participants connected the story to their cultural and religious backgrounds, finding similarities with familiar tales and traditions, which deepened their engagement with the narrative.
	• When someone tells you a story, there is a personal touch to it. But this is more like **escapism**. One feels less warm and connected, but this does feel more novel and free. (NVP4) • I think nowadays, a lot of people try to **trick you into doing something, like scammers online**, so just watch out for it and be clever, so you **don't get tricked**. (VP9) • **Be humble**, don't let others trick you because you're not humble. (VP9)	**D4 - Moral Lessons and Awareness:** Participants reflected on the moral lessons presented in the story, considering how these teachings applied to their behavior and awareness in situations like online scams and humility.

Figure 13: Thematic analysis results: Reflection.

E - Culture: The storytelling increased appreciation for African folklore, enriching participants' understanding of cultural heritage and promoting cultural exchange.	• I **think African stories are very far away from me. But this game made it so close to me**. So I was **more interested, even though I am not, usually.** (VP6) • I appreciated all cultures and find it fascinating to see **how different cultures differ in so many activities but share common values of life**, but it was nice to learn the characters that were represented like the sky god and the spiders. (VNP5) • After this experience I am **eager** to learn more about this story and culture. (VNP6)	**E2 - Appreciation and Interest:** The immersive storytelling made the culture feel more accessible and relevant, even for those who initially felt distant from it.
	• Although familiar with Anansi and spider stories, said that in his region of Kenya, they are not very popular. **Animal morals contain animals specific to the area that the culture comes from.** It is usually more about animals from the wild, and not spiders where I am from. (VNP2) • Growing up, every time **my family members would say a word which we don't know, they always had a story behind it**, so they have to tell us a story to show us what it actually means and why it's still relevant today. (VP8)	**E3 - Cultural Authenticity and Representation:** Reflections on the authenticity of cultural portrayals, emphasizing the importance of accurate and resonant cultural elements.
	• About African culture: I learned that **animals represent some emotions and authority figures**, and want to share a moral through animal figures. **It is also like this in my culture, Turkish culture**, because animals were there before humans. They use animals that we face in our daily lives, and they need to represent you know, some deeper meaning, like strong authority figures, like snakes, huge spiders, you may be scared of them if you see them in real life, right? So that's why, I think that's how they are trying to explain something bigger in the story. (VNP3) • I have this group of people from **India** and **we meet every week** and we talked about how in today's generation, it is less storytelling that what kids are attracted to, it is more like video games, so we **talked about video games to share the routes that the heritage and they are coming from, maybe some of the old warriors.** (VP8)	**E4 - Relation to Personal Cultural Background:** The immersive experience prompted connections between African folklore and participants' own cultural traditions, deepening their appreciation of their heritage.
	• After the story, I thought to myself: **Wow, two incidents about Africa I need to learn about.** (NVP2) • I will also **tell my niece and nephew about this story.** (NVP2)	**E5 - Cultural Exchange and Sharing:** The storytelling inspired participants to share their newfound cultural insights with others, promoting wider dissemination of African narratives.

Figure 14: Thematic analysis results: Culture.

E - Technological Intervention: The changes of medium such as VR and AI, transform the way participants engage with and learn about culture, enhancing both interest and understanding through immersive and interactive experiences.	• This was **more interesting than previous VR experiences** because I felt like I was **learning something.** Previously, I was doing tiny actions and couldn't see a clear purpose, but while doing this experience, I felt like I was **learning about a new culture** and I found that really interesting. (VNP6)	**E1 - Changes in interest or Attitudes towards African Culture:** The use of VR shifted participants' perceptions, increasing their interest in and appreciation for African culture through a more engaging and impactful experience.
	• Oh big time. Because, of course, the generation before us, they are already grown up and already know these things, but the generation right now and the **generation** which is coming would be more **interested towards technology, AI, and VR**, because they are already **playing games, have mobile phones**, etc. It is a **way to make them understand their culture**. (VP8) • It's sometimes **difficult for people to travel to Peru** to experience how the culture is, and it's different than reading about it. **I think VR could be a really good alternative**. (VNP6) • You can educate about different cultures, not just folklore stories, but things like culture aspects that you can **only learn by going to Africa, a particular city in Africa**, to get the experience of how the people live their life there, so we can **appreciate it more**. (VNP5)	**E2 - Educational Impact and Learning:** VR and AI facilitated deeper cultural learning by providing an immersive experience that made complex cultural aspects more accessible and easier to understand.

Figure 15: Thematic analysis results: Technological Intervention.