

Enhancing museum visitor experience through ai assistants and digital environments: An integrated framework based on hybrid intelligent service ecosystems and customer citizenship behavior

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INTRODUCTION

As AI increasingly permeates daily life, it is also reshaping the organizational cultures of marketing practitioners. Across commercial sectors, AI and related technologies are being widely adopted to enhance consumer experiences and consequently to strengthen competitive positioning and market share. Building on AI's demonstrated efficacy in diverse commercial settings, cultural heritage institutions like museums are undergoing a paradigm shift in digital services—moving from static “information display” toward dynamic “intelligent interaction” (Xu et al., 2024; Yap et al., 2024). Current modes of digital integration in museums exhibit considerable heterogeneity, primarily including: (1) mobile-based audio guides and multimedia content delivery; (2) interactive touchscreens and motion-sensing installations; (3) immersive viewing environments created through virtual reality (VR) and augmented reality (AR); (4) digital collection management systems and online archival databases; (5) interactive viewing modules on social media platforms, and (6) intelligent terminal devices such as guide robots (Wang et al., 2024; Choi & Nam, 2024; Tang & Zhou, 2025).

Within tourism scholarship, there is now broad consensus that visitors' experiences with AI are not singularly defined by instrumental criteria such as “perceived usefulness” or “ease of use”. Rather, these experiences unfold across a multidimensional set of reactions throughout the journey, including emotional, cognitive, social, and behavioral dimensions (Puntoni et al., 2021). The AI-CX multidimensional framework offers a comprehensive lens for analyzing how AI-mediated services shape consumers' journey perceptions and value judgments from holistic, emotional, and interactive perspectives. Concurrently, measurement frameworks and operational mechanisms for Customer AI Experience (CAE/AI-CX) are evolving: recent scale development research confirms that subjective experiences formed after customer-AI interactions comprise multiple dimensions, which further influence satisfaction, trust, and subsequent behaviors (Li et al., 2025). Nevertheless, critical gaps persist in the literature: First, AI-CX studies remain heavily concentrated on “transactional services” such as e-commerce, banking, and customer service, with insufficient attention to “cultural and tourism experiential services”—particularly the educational/knowledge, aesthetic, and social interaction dimensions within museum visits (Li et al., 2025). Second, in hybrid service environments where “human/AI/human+AI” modalities coexist, value co-creation is fundamentally relational and configuration-dependent. The formation mechanism of visitor experiences may depend on the configuration of human and AI agency, resource integration pathways, and institutional arrangements (Bartelheimer et al., 2025). Previous scholars have not explored the differences among these three modes. Therefore, this study focuses on the context of museum intelligent guided tours. Grounded in the AI-CX framework and centered on the three service provider configurations—“human, AI, and human+AI hybrid narration”—it explores how digital personalization capabilities and environmental stimulus features jointly influence visitors' knowledge-sharing willingness and value co-creation behaviors.

THEORETICAL FRAMEWORK

Hybrid Intelligent Service Ecosystem

Bartelheimer et al. (2025) introduced the “Hybrid Intelligent Service Ecosystem (HISE)” to explain systemic shifts in service value co-creation amid widespread AI adoption. HISE identifies three types of actors within the ecosystem: human actors, AI actors, and “human–AI hybrids.” Crucially, it posits that the value co-creation process is jointly guided and constrained by shared resources and institutional arrangements, with its key characteristic being the emergence and configuration of “hybrid agency.” This framework not only elevates AI from a mere “tool” to an actor capable of participating in

exchange and collaboration, but also underscores that the division of agency between humans and AI is not static. Instead, agency distribution adapts responsively to task complexity, real-time contextual cues, risk profiles, ethical boundaries, and normative expectations. For museum intelligent guided tours, HISE helps explain why, under identical digital infrastructure, different venues/tour solutions yield differentiated visitor experiences; and why “human-AI hybrid narration” may achieve superior balance among informational accuracy, narrative authenticity, and interactive responsiveness, thereby promoting value co-creation (Bartelheimer et al., 2025).

Customer Citizenship Behavior (CCB)

Customer Citizenship Behavior Theory (CCB) originates from organizational behavior’s classic distinction between employees’ in-role and out-of-role behaviors. It evolved from Schmitt in 1993 (Schmitt et al., 1993) seminal framework on task performance and contextual performance. Against the backdrop of the Service-Dominant Logic paradigm, Yi (2011) extended this theoretical framework to customer behavior research, systematically constructing a theoretical model of Customer Value Co-creation Behavior (Yi et al., 2011). Within this model, customer citizenship behaviors (CCBs) are defined as voluntary, non-contractual, role-transcending actions that customers undertake *during and beyond* service interactions to enhance collective value creation.

The Citizen Behavior Theory (Yi et al., 2011) positions customers not as passive consumers but as active co-creators of interpretive value. It identifies four categories of voluntary, role-extended behaviors: feedback, advocacy, assistance, and tolerance.

METHOD

Based on the previous studies, the research model has been shown in Figure 1.

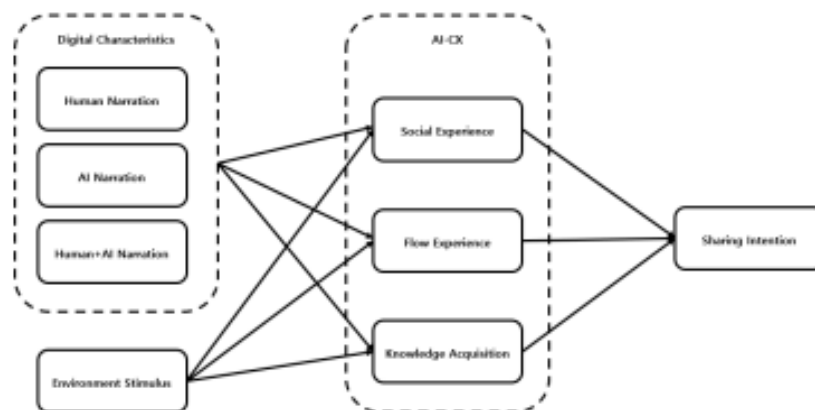


Figure 1. Research Model

This study employs a mixed-methods experimental design. Participants engaged with a standardized museum exhibition scenario through three rigorously matched visual–narrative stimuli sets, each representing one service configuration: human narration, AI narration, and human+AI narration. This immersion facilitated precise responses to core research questions concerning social experience, flow experience, knowledge acquisition, and sharing intention. The experimental setting was selected from a permanent exhibition hall at a provincial-level history museum. The site was chosen for two primary reasons: first, its exhibits possess educational value with varying knowledge density and narrative intensity; second, the museum receives approximately 3,000 daily visitors, providing sufficient sample size for on-site experimentation. A preliminary experiment will first recruit 50 visitors who have previously visited the museum through the Wenjuanxing platform. Subsequently, 300 visitors across different age groups who have visited the museum will be recruited via Wenjuanxing for the formal experiment. The anticipated sample size is expected to meet analytical requirements.

The experimental task consists of two stages: Stage 1: Participants freely select their preferred interpretation method from the provided images based on their typical visiting habits. Stage 2: After making their selection, participants complete an electronic questionnaire.

Stimuli comprise two categories: exhibits and types of interpretation. The exhibit shown in the image was selected based on recommendations from curators and explanatory effectiveness, ultimately chosen as an obscure plain ceramic jar. AI explanations sourced from the museum's commercial smart guide system, which generates corresponding text based on narrated content. Human explanations derive from transcribed recordings of live docents in the same exhibition hall, with text content largely consistent between AI and human explanations.



Figure 2. Experimental Stimuli

The measurement tools for this study comprised three components. First, Artificial Intelligence–Customer Experience (AI-CX) employed Puntoni et al (2021) multidimensional experience framework, measuring 12 items across four dimensions—emotional, cognitive, social, and behavioral. Second, visitor value co-creation behaviors utilize the Customer Value Co-Creation Behavior Scale developed by Yi&Gong (2008). The original scale comprises two dimensions—participatory behaviors (information seeking, information sharing, responsible behaviors, interpersonal interactions) and civic behaviors (feedback, advocacy, assistance, tolerance), totaling 29 items. Third, control variables—visiting motivation, prior experience, and technological anxiety—were measured using established scales. All items employed a 7-point Likert scale.

The collected experimental data were analyzed using SPSS software. Demographic data were first gathered. Prior to subsequent analyses, exploratory factor analysis (EFA) was conducted to examine the structural validity of the research model. Subsequently, ANOVA was used to test differences among the three interpretation modes: human-led, AI-led, and human-AI hybrid (mixed) interpretation. Finally, the PROCESS procedure was employed to examine the mediating and moderating effects within the research model.

FINDINGS

This study proposes a set of competing hypotheses to compare the differential effects of three interpretation modes on visitor experience and civic behavior. Specifically: human expert narration is anticipated to exert a significant positive effect on visitors' experience perception but may not significantly influence civic behavior. AI narration is similarly expected to correlate positively with experience perception, though its effect on civic behavior may also be nonsignificant. In contrast, the human+AI hybrid narration model is projected to exert significant positive effects on both visitor perception and their civic behavior.

IMPLICATIONS CONCLUSION

This study introduces HISE into the scenario of museum intelligent guided tours, proposing that “types of guided service providers (human/AI/human+AI hybrid)” can be regarded as the specific form of the configuration of hybrid agency configurations. This transformation translates theoretical propositions at the ecosystem level into testable empirical models (Bartelheimer et al., 2025).

Second, this study introduces the experiential dimension of cultural tourism into the AI-CX research tradition. It conceptualizes “knowledge experience, social experience, and interactive experience” as contextual manifestations of AI-CX, aligning with scholarly insights on the multidimensional nature of digital museum experiences (Zhu et al., 2024) and thereby expanding the scope of AI-CX within experiential services.

Finally, from a governance perspective pertaining to hybrid intelligence service experiences, museums must establish institutional frameworks encompassing AI participation disclosure, content moderation, and risk response. This ensures ethical data usage and content accountability, thereby supporting sustainable long-term value co-creation. In summary, grounded in HISE and hybrid service encounter theory, this study constructs a causal chain linking “digital guide characteristics—AI-CX.” By examining its effects on visitor engagement and value co-creation across three service provider configurations, it aims to offer novel theoretical and empirical foundations for research on customer experience and value co-creation in the service and tourism sectors in the AI era.

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