

VIRTUAL AVATAR CHARACTERISTICS IN DIGITAL HERITAGE: A SYSTEMATIC REVIEW OF THEIR IMPLICATIONS FOR USER EXPERIENCE

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Abstract: *As digital technologies continue to transform cultural heritage experiences, virtual avatars have become an increasingly important component of digital heritage environments. Despite growing scholarly attention, existing studies have mainly focused on isolated technologies, individual outcomes, or specific application contexts, leading to a lack of integrated understanding regarding how multiple avatar characteristics shape user experiences in digital heritage environments. This study aims to synthesize the existing literature on virtual avatars in digital heritage contexts and identify the major characteristics that contribute to user experiences and future applications. A systematic literature review based on the PRISMA 2020 guidelines was conducted, and the retrieved studies were analyzed through thematic analysis. The findings reveal four recurring characteristics of virtual avatars, namely visual appearance, communication style, technical functionality, and cultural representation. These characteristics collectively shape users' perceptions, interactions, and experiences and provide a multidimensional understanding of avatar design in digital heritage environments. Overall, the findings suggest that effective virtual avatar design depends on the integration of visual, communicative, functional, and cultural dimensions, which together contribute to more engaging, immersive, and meaningful digital heritage experiences and offer practical implications for future virtual avatar development.*

Keywords: *Virtual avatar; Digital heritage; User experience*

Introduction

The rapid advancement of digital technologies has fundamentally transformed the ways in which cultural heritage is preserved, interpreted, and communicated, enabling museums and heritage institutions to evolve from object-centred exhibitions toward more interactive, immersive, and visitor-oriented experiences (Trunfio et al., 2022). As part of this digital transformation, immersive technologies—including virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and interactive media—have created new opportunities for enhancing cultural interpretation and audience engagement in digital heritage environments (Clini et al., 2024). Previous studies have further demonstrated that VR and AR have accelerated the digital transformation of heritage tourism by supporting more immersive and engaging cultural experiences (Siddiqui et al., 2022). As digital heritage environments continue to evolve, museums have increasingly adopted technologies that support more natural, personalised, and socially engaging interactions. Within this evolving landscape, virtual avatars have emerged as an increasingly important component of digital heritage experiences (Qu et al., 2025).

As the application of virtual avatars has expanded across museums and cultural heritage contexts, scholarly interest in this field has grown considerably (Qu et al., 2025). This growing body of research reflects the increasing recognition of virtual avatars as interactive agents that facilitate cultural communication and enrich visitor experiences in digital environments (Gong et al., 2024). Accordingly, researchers have increasingly explored how virtual avatars influence users' perceptions, emotions, and behaviours during human–computer interactions (Baker et al., 2023). Among the various factors investigated, interaction quality and social presence have consistently been identified as key determinants of user engagement and overall experience, highlighting the important role of virtual avatars in creating meaningful digital heritage experiences (Kim & Jo, 2022).

Despite the growing body of literature, research on virtual avatars remains fragmented across multiple disciplines, including tourism, marketing, digital media, and human–computer interaction, resulting in dispersed knowledge and limited integration within museum and cultural heritage contexts (Qu et al., 2025). Existing review studies have primarily focused on technological developments and marketing perspectives, while relatively little attention has been devoted to systematically synthesising the characteristics of virtual avatars in museums and cultural heritage environments (Baker et al., 2023). Consequently, there remains a lack of an integrated understanding of how different virtual avatar characteristics contribute to user experience in digital heritage settings. Addressing this gap requires a systematic synthesis of the existing literature to provide a more comprehensive understanding of current research and inform future virtual avatar development in museum and cultural heritage contexts (Qu et al., 2025).

Building upon the identified research gaps, this systematic literature review synthesises and critically examines the existing literature on virtual avatars in digital heritage contexts. Specifically, the review seeks to answer the following research questions: (1) What is the current state of research on virtual avatars in digital heritage contexts? (2) What characteristics of virtual avatars have been discussed in previous studies? (3) What implications do these characteristics have for user experience and future applications in digital heritage contexts?

This review contributes to the literature in three ways. First, unlike previous reviews that have primarily focused on technological developments or marketing perspectives, it provides a

comprehensive overview of research on virtual avatars in digital heritage contexts. Second, it systematically synthesises the major characteristics of virtual avatars identified in previous studies through thematic analysis. Third, it discusses the implications of these characteristics for user experience and future applications in museums and cultural heritage environments, while identifying directions for future research.

Literature Review

Virtual Avatars

Virtual avatars have emerged as an important research topic across multiple disciplines, including tourism, marketing, human–computer interaction, and digital media studies (Qu et al., 2025). Although definitions vary across contexts, virtual avatars are generally regarded as computer-generated characters capable of interacting with users through visual, verbal, and behavioral cues, thereby facilitating social interaction and information exchange in digital environments (Sylaiou & Fidas, 2022; Liu et al., 2026). Their applications have gradually expanded from entertainment and commercial settings to service, educational, and cultural domains, reflecting the increasing importance of human–computer interaction and intelligent communication in contemporary digital experiences (Qu et al., 2025).

Previous studies have emphasized that virtual avatars possess anthropomorphic characteristics that facilitate social interaction and emotional communication with users (Song et al., 2026). The degree of realism and human likeness has been found to influence users' perceptions of comfort, trust, and naturalness during interactions (Song et al., 2026; Sorosrungruang et al., 2024). Moreover, verbal and non-verbal communication enables virtual avatars to establish social presence and enhance users' perceptions of co-presence in digital environments (Kim & Jo, 2022). Recent research has further suggested that virtual avatars provide multiple affordances, including interactivity, identity expression, creativity, and embodiment, which contribute to richer and more immersive experiences (Liu et al., 2026). Consequently, virtual avatars are increasingly regarded as intelligent agents capable of supporting user engagement and experience creation across diverse contexts (Qu et al., 2025).

Virtual Avatars in Digital Heritage

The rapid digitalization of museums and cultural heritage institutions has facilitated the adoption of virtual avatars in heritage interpretation and visitor services (Clini et al., 2024). Virtual avatars are increasingly used as digital guides, companions, and mediators to communicate cultural information and enhance visitor engagement (Sylaiou & Fidas, 2022). Compared with traditional information delivery approaches, avatar-based interactions provide more personalized and immersive experiences, thereby improving visitors' understanding of cultural content and increasing their emotional involvement (Sylaiou & Fidas, 2022).

Recent studies have demonstrated that immersive technologies, including VR and AR, can significantly enhance museum experiences and transform heritage services into more interactive and experience-oriented systems (Trunfio et al., 2022). Similarly, digital storytelling platforms and virtual heritage environments have enabled museums to present cultural narratives in innovative ways, improving accessibility and public participation (Clini et al., 2024). Gong et al. (2024) further argued that user-centered experience design plays an important role in maximizing the effectiveness of virtual heritage exhibitions. These developments suggest that virtual avatars have evolved from simple information providers to

active participants in cultural communication and experience co-creation (Sylaiou & Fidas, 2022).

Furthermore, virtual avatars have been increasingly integrated with artificial intelligence technologies, enabling more adaptive and interactive communication between users and digital systems (Zhang et al., 2025). Such developments provide museums and heritage institutions with new opportunities to deliver personalized experiences and improve knowledge dissemination through intelligent interactions (Hung & Lee, 2025). Consequently, virtual avatars have become an essential component of digital heritage ecosystems and have attracted growing scholarly attention (Qu et al., 2025).

User Experience and Avatar Design

User experience has become a central concern in studies investigating virtual avatars and digital heritage applications (Baker et al., 2023). Existing research suggests that visitor experiences are shaped by multiple factors, including presentation quality, content design, and functional performance (Baker et al., 2023). Positive interactions with virtual avatars have been associated with increased engagement, satisfaction, immersion, and behavioral intentions (Baker et al., 2023; Trunfio et al., 2022).

Previous studies have shown that communication strategies adopted by virtual humans influence users' emotional responses and cognitive evaluations (Yin et al., 2026). Language styles and emotional expressions can affect users' perceptions and subsequently shape behavioral outcomes (Xia et al., 2025). In addition, technological affordances, such as interactivity, responsiveness, and embodiment, contribute to users' engagement and immersive experiences (Hung & Lee, 2025; Liu et al., 2026). Researchers have also emphasized the importance of authenticity and congruence between virtual characters and cultural contexts in fostering trust and emotional attachment among users (Cheng et al., 2026; Luo et al., 2025).

Despite the increasing number of studies, previous findings remain scattered across different disciplines and research contexts (Qu et al., 2025). Existing studies often focus on isolated aspects of virtual avatars and provide fragmented explanations regarding their influence on user experiences (Baker et al., 2023). In addition, studies conducted in tourism, marketing, and human-computer interaction frequently employ different theoretical perspectives and methodological approaches, resulting in a lack of integrated understanding (Sylaiou & Fidas, 2022). Therefore, a comprehensive synthesis of the existing literature is necessary to provide a clearer understanding of the characteristics of virtual avatars and their implications for digital heritage experiences.

Methodology

This study adopts a systematic literature review approach to synthesize existing knowledge on virtual avatars in digital heritage contexts. The review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, which provide a widely accepted framework for ensuring transparency, rigor, and reproducibility in systematic reviews (Page et al., 2021). Following the PRISMA framework, this section describes the procedures for identification, screening, eligibility assessment, and data extraction.

Search Strategy

Following the PRISMA 2020 guidelines, a systematic search was conducted to identify relevant studies on virtual avatars in digital heritage contexts (Page et al., 2021). Comprehensive

searches were performed across Scopus, Web of Science Core Collection, and IEEE Xplore. A structured search strategy based on predefined keywords and Boolean operators was employed to retrieve relevant records (Table 1). In addition, Google Scholar was consulted as a supplementary source to identify additional records and relevant references.

Table 1: The Search Strings

Scopus	(artificial intelligen* OR AI OR AIGC OR "generative AI") AND (avatar* OR "digital human*" OR "virtual human*" OR "virtual character*" OR "virtual influencer*" OR "AI influencer*") AND (tourism OR heritage OR museum*) AND (experien* OR interact* OR engag* OR immers*)
Web of Science	(artificial intelligen* OR AI) AND (avatar* OR "digital human*" OR "virtual human*") AND (tourism OR heritage OR museum*) AND (experien* OR interact* OR engag*)
IEEE Xplore	(artificial intelligen* OR AI) AND (avatar* OR "digital human*" OR "virtual human*") AND (tourism OR heritage OR museum*)

Inclusion and Exclusion Criteria

These criteria were established to ensure that the selected studies were relevant and met the objectives of the review (Table 2). The inclusion and exclusion criteria were designed to ensure the consistency and relevance of the selected studies. These criteria were applied independently by two reviewers to ensure objectivity and to minimise bias in the selection of studies. It was decided to limit the search to studies published from 2021 onwards, as this period witnessed rapid developments in virtual avatar technologies, AIGC-based systems, and digital heritage applications.

Table 2: Inclusion And Exclusion Criteria

Criteria	Inclusion Criteria	Exclusion Criteria
Publication period	Published between 2021—present (June 2026)	Published before 2021
Type of document	Peer-reviewed journal articles	Not an article published in a peer-reviewed journal
Type of study	Empirical, conceptual, and review studies	Other research (Editorials, opinions, letters to the editor...)
Language	English	Non-English
Context	Museums, cultural heritage, tourism, and immersive digital environments	Contexts unrelated to cultural heritage and tourism
Research topic	Virtual avatars in digital heritage	Studies unrelated to virtual avatars or digital heritage
Accessibility	Full-text available	Abstract-only or inaccessible studies

Study Selection

A total of 254 records were identified in the three electronic databases analysed. After removing duplicate records (n = 39), studies were reviewed by title and abstracts to assess eligibility (n = 215). A total of 188 studies were excluded as they did not meet the established inclusion and exclusion criteria. Finally, a total of 27 studies were eligible for inclusion in the review. Figure

1 shows the flow chart of the record selection process based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

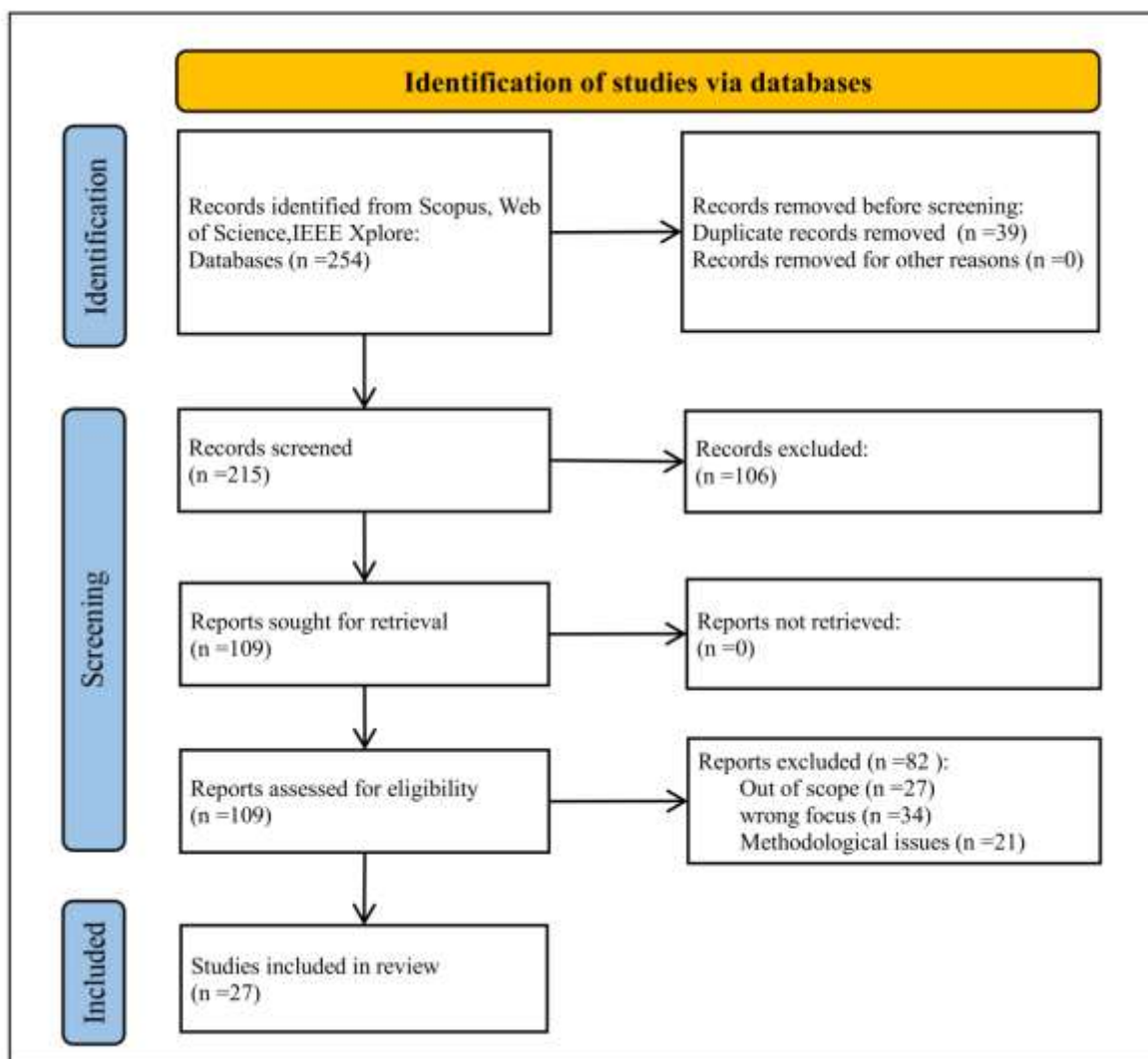


Figure 1: PRISMA 2020 Flow Diagram Of the Study Selection Process

Data Extraction

Each of the 27 eligible studies was reviewed and coded independently to identify recurring ideas, variables, and patterns. The extracted information included the authors, publication year, research context, research methods, and major findings. Similar observations were subsequently grouped into broader analytical categories through thematic analysis. The coded data were reviewed repeatedly to ensure internal consistency and conceptual distinction among categories. Any discrepancies in coding or classification were resolved through discussion and re-examination of the original studies.

Findings

The reviewed studies were published between 2021 and 2026 and covered diverse contexts, including museums, cultural heritage sites, tourism destinations, and immersive digital environments. Various research methods were employed, including experiments, surveys, case studies, and conceptual analyses. Despite differences in research contexts and methodologies, several recurring patterns emerged across the reviewed literature. The studies consistently

emphasized the importance of avatar-related characteristics in shaping users' perceptions and experiences in digital heritage environments. A summary of the included studies is presented in Table 3. Through thematic analysis, four major themes were identified from the reviewed studies, namely visual appearance, communication style, technical functionality, and cultural representation. These themes represent the most frequently discussed characteristics of virtual avatars and provide the basis for the following analysis.

Table 3: Themes and Representative Studies

Theme	Representative Studies	Key Findings
Visual Appearance	Song et al. (2026); Nukhu et al. (2025); Sorosrungruang et al. (2024); Kim & Jo (2022); Baker et al. (2023)	Human-like appearance, anthropomorphism, realism, attractiveness, and expressive features enhance social presence, trust, and emotional responses.
Communication Style	Yin et al. (2026); Xia et al. (2025); Huang et al. (2025); Zhang et al. (2025); Baker et al. (2023)	Communication strategies, emotional expression, and interactive communication improve users' understanding, emotional responses, and engagement.
Technical Functionality	Liu et al. (2026); Hung & Lee (2025); Kim & Jo (2022); Clini et al. (2024); Sylaiou & Fidas (2022)	Interactivity, responsiveness, immersive technologies, and intelligent functions facilitate personalized and engaging experiences.
Cultural Representation	Cheng et al. (2026); Luo et al. (2025); Gong et al. (2024); Qu et al. (2025); Baker et al. (2023)	Cultural authenticity, identity, narratives, and emotional attachment strengthen meaningful connections with heritage content.

Visual Appearance

Visual appearance emerged as one of the most frequently discussed characteristics of virtual avatars in digital heritage environments. Across the reviewed studies, visual appearance was commonly associated with anthropomorphism, realism, attractiveness, and facial expressions, all of which influence users' perceptions during interactions with virtual characters (Song et al., 2026). Previous studies have consistently emphasized that visual design serves as the first point of contact between users and virtual avatars and contributes to the formation of social presence and immersion (Kim & Jo, 2022).

Anthropomorphic and realistic appearances were repeatedly identified as important design elements. Users also tend to anthropomorphize AI-based virtual characters, which strengthens perceptions of social presence and emotional connection during interactions (Nukhu et al., 2025). Sorosrungruang et al. (2024) reported that human-like avatars enhanced users' perceptions of naturalness and emotional responses. Similarly, Song et al. (2026) found that realistic visual representations increased users' feelings of comfort and familiarity during interactions. Research conducted by Baker et al. (2023) further indicated that human-like characteristics positively influenced users' trust and acceptance of virtual characters. These findings suggest that anthropomorphic appearance remains an important feature in the design of virtual avatars.

In addition to realism, facial expressions and visual attractiveness were also frequently highlighted in the literature. Kim and Jo (2022) demonstrated that realistic appearance and expressive characteristics enhanced social presence and immersion in virtual environments. Xia et al. (2025) similarly noted that users tended to respond more positively to visually appealing virtual characters. Studies focusing on tourism and digital media contexts also showed that visual appearance affects users' initial perceptions and emotional reactions toward virtual avatars (Qu et al., 2025; Zhang et al., 2025).

Although most studies emphasized the advantages of anthropomorphic and realistic designs, the reviewed literature revealed differences in the degree of realism adopted by virtual avatars. Some studies preferred highly realistic representations to improve authenticity and immersion, whereas others employed stylized or cartoon-like characters to enhance accessibility and user acceptance (Sylaiou & Fidas, 2022; Gong et al., 2024). Overall, the findings indicate that visual appearance constitutes a fundamental characteristic of virtual avatars and plays an important role in shaping users' perceptions and experiences in digital heritage environments.

Communication Style

Communication style emerged as another important theme in the reviewed studies. It encompasses the ways in which virtual avatars deliver information, express emotions, and interact with users through verbal and non-verbal communication (Kim & Jo, 2022). In digital heritage environments, virtual avatars often serve as guides and interpreters, making effective communication essential for cultural knowledge transmission (Clini et al., 2024).

Several studies highlighted the importance of language style in influencing users' perceptions and responses. Yin et al. (2026) found that communication strategies adopted by digital humans affected users' attitudes and behavioral intentions. Similarly, Xia et al. (2025) reported that conversational styles and information delivery influenced visitors' satisfaction and experience quality. These findings suggest that communication effectiveness depends not only on information content but also on how the information is conveyed.

Emotional expression was also frequently emphasized in the literature. Huang et al. (2025) identified expressiveness as an important factor affecting users' perceptions of digital humans. Likewise, Zhang et al. (2025) showed that interactive communication enhanced user engagement compared with conventional information delivery approaches. In addition, verbal and non-verbal interactions were found to strengthen social presence and immersive experiences (Sylaiou & Fidas, 2022).

Beyond information delivery, communication style also contributes to users' perceptions of intimacy and companionship during interactions. Baker et al. (2023) suggested that human-like communication facilitates trust and enhances users' emotional connections with virtual characters. Qu et al. (2025) further noted that the increasing use of virtual avatars in tourism and digital media has shifted attention from technological functions to more personalized and socially oriented communication. As a result, communication style has gradually evolved from a supplementary feature to a central component of user experience.

Overall, the reviewed studies indicate that communication style represents a key characteristic of virtual avatars and contributes to users' cognitive understanding, emotional responses, and engagement in digital heritage environments.

Technical Functionality

Technical functionality emerged as another major theme in the reviewed studies. It generally refers to the capabilities of virtual avatars to provide interactive, responsive, and immersive experiences through digital technologies (Liu et al., 2026). In digital heritage environments, technical functionality determines how effectively avatars communicate with users and support information delivery (Trunfio et al., 2022).

Interactivity was one of the most frequently discussed functional characteristics. Liu et al. (2026) reported that interactive capabilities significantly enhanced users' engagement with digital avatars. Similarly, Hung and Lee (2025) found that intelligent docent systems improved learning experiences by providing responsive and context-sensitive interactions. These findings indicate that users increasingly expect virtual avatars to provide dynamic rather than static experiences.

Responsiveness and technological affordances were also emphasized in the literature. Kim and Jo (2022) demonstrated that responsive interactions contributed to users' perceptions of social presence and immersion. Likewise, Zhang et al. (2025) showed that AI-enabled avatars were more effective in sustaining users' attention and participation than conventional information delivery approaches. In museum and heritage settings, these functions allow avatars to provide personalized guidance and real-time feedback (Clini et al., 2024).

In addition, immersive technologies, including virtual reality and augmented reality, further expanded the functionality of virtual avatars. Sylaiou and Fidas (2022) highlighted that the integration of immersive technologies strengthened users' experiences and facilitated more engaging cultural interactions. Overall, the reviewed studies indicate that technical functionality plays a critical role in enhancing interactivity, responsiveness, and immersion in digital heritage environments.

Cultural Representation

Cultural representation emerged as a recurring theme in the reviewed studies. In digital heritage environments, virtual avatars not only serve as information providers but also function as carriers of cultural meanings and identities (Sylaiou & Fidas, 2022). Through visual symbols, narratives, and culturally embedded interactions, virtual avatars contribute to the communication and interpretation of heritage content (Clini et al., 2024).

Several studies emphasized the importance of cultural authenticity in shaping users' perceptions of virtual avatars. Cheng et al. (2026) found that authentic cultural elements enhanced users' trust and emotional attachment. Similarly, Luo et al. (2025) reported that destination congruence strengthened users' perceptions of credibility and improved their connections with digital characters. These findings suggest that cultural consistency is an important factor influencing users' evaluations of virtual avatars.

The reviewed literature also highlighted the role of virtual avatars in promoting local identity and cultural storytelling. Gong et al. (2024) noted that virtual humans provide new opportunities for presenting cultural heritage through immersive and interactive experiences. Likewise, Qu et al. (2025) indicated that virtual avatars increasingly act as mediators between users and cultural content, facilitating more personalized and meaningful experiences. In tourism contexts, culturally representative avatars have been found to strengthen users' emotional engagement and destination image (Baker et al., 2023).

In addition, studies suggested that cultural representation extends beyond visual symbols and includes values, narratives, and social meanings associated with heritage resources (Trunfio et al., 2022). Overall, the reviewed studies indicate that cultural representation is an essential characteristic of virtual avatars and contributes to authenticity, identity construction, and emotional attachment in digital heritage environments.

Discussion

To address the research questions posed in this study, the findings obtained from the reviewed literature are discussed from three perspectives. The discussion focuses on the current state of research on virtual avatars in digital heritage contexts, the major characteristics identified in previous studies, and the implications of these characteristics for user experience and future applications.

Q1: What is the current state of research on virtual avatars in digital heritage contexts?

The findings indicate that research on virtual avatars in digital heritage environments has expanded rapidly in recent years. Existing studies demonstrate a shift from technology-oriented perspectives toward experience-oriented approaches, with increasing attention being paid to user engagement, immersion, and cultural communication (Trunfio et al., 2022). In addition, research in this area has become increasingly interdisciplinary, integrating perspectives from tourism, digital media, human–computer interaction, and cultural heritage studies (Baker et al., 2023). This shift also reflects the increasing importance of user-centered experience models in virtual heritage exhibitions, where interaction design and visitor perception are treated as central components of digital heritage experience (Gong et al., 2024). Recent developments in artificial intelligence and immersive technologies have further accelerated the application of virtual avatars in museums and heritage sites, transforming them from simple information providers into interactive and socially engaging agents (Gong et al., 2024). As noted by Qu et al. (2025), virtual avatars have gradually evolved into important mediators between users and cultural content, reflecting a transition from technology-centered systems to experience-centered services.

Q2: What characteristics of virtual avatars have been discussed in previous studies?

The findings reveal four recurring characteristics of virtual avatars, namely visual appearance, communication style, technical functionality, and cultural representation. Rather than functioning independently, these characteristics jointly contribute to users' experiences in digital heritage environments. Visual appearance influences users' first impressions and perceptions of realism, whereas communication style shapes cognitive and emotional responses during interactions (Kim & Jo, 2022). Technical functionality determines the degree of interactivity and responsiveness provided by virtual avatars, while cultural representation enhances authenticity and strengthens emotional connections with heritage content (Cheng et al., 2026). This multidimensional understanding is consistent with the affordance perspective, which suggests that avatars create value through interactivity, identity expression, creativity, and embodiment rather than through a single isolated feature (Liu et al., 2026). Similarly, research on AI virtual streamers shows that persona, anthropomorphism, and interactivity are key dimensions of digital human design, which further supports the need to examine avatar characteristics as an integrated system (Zhang et al., 2025). Collectively, these findings suggest that the effectiveness of virtual avatars depends on the integration of multiple dimensions rather than on a single design attribute. Similar conclusions have been reported in studies on AI

avatars, where engagement strategies and interactive communication were found to improve user acceptance (Han et al., 2025). Compared with earlier studies that focused primarily on technological innovation, recent research increasingly emphasizes the interplay between functional performance and cultural meaning (Sylaiou & Fidas, 2022).

Q3: What implications do these characteristics have for user experience and future applications in digital heritage contexts?

The reviewed studies indicate that virtual avatars contribute to user experience by facilitating information delivery, increasing engagement, and promoting emotional attachment to cultural content (Clini et al., 2024). This observation is consistent with tourism studies showing that users actively engage with virtual influencers and perceive them as meaningful interaction partners (Xie-Carson et al., 2023). For museums and heritage institutions, the findings suggest that the development of virtual avatars should extend beyond technological considerations and incorporate communication strategies and cultural authenticity. Interactive docent systems also indicate that virtual avatars can support more adaptive and situated learning experiences by responding to visitors' needs and exhibition contexts (Hung & Lee, 2025). From a practical perspective, integrating visual design, interactive capabilities, and culturally meaningful narratives may improve visitors' experiences and strengthen cultural interpretation. Beyond museums, virtual avatars have also been employed as destination ambassadors to enhance social media engagement and destination communication (Lin et al., 2025). They may also contribute to more sustainable tourism experiences through immersive digital interactions (Liu & Hao, 2024). Recent studies further suggest that avatars may support more inclusive and immersive tourism experiences across different visitor groups (Hao et al., 2024). Despite the growing body of literature, several issues remain underexplored. Recent studies have also highlighted the potential risks and ethical challenges associated with AI-generated virtual humans (Yang et al., 2025). Existing studies are predominantly cross-sectional and context-specific, with relatively limited attention given to cross-cultural comparisons and long-term user experiences. In addition, recent developments in generative AI and metaverse technologies suggest that future virtual avatars may become more adaptive, multimodal, and context-aware in digital heritage environments (Zhou et al., 2025). Future studies may therefore benefit from adopting longitudinal approaches, investigating different cultural settings, and developing integrative frameworks that explain how multiple avatar characteristics collectively influence user experiences (Qu et al., 2025).

Conclusion

This study synthesized the existing literature on virtual avatars in digital heritage contexts and identified four recurring characteristics, namely visual appearance, communication style, technical functionality, and cultural representation. The findings indicate that these characteristics jointly influence users' perceptions, interactions, and experiences and represent the major dimensions through which virtual avatars contribute to digital heritage environments.

The review demonstrates that research on virtual avatars has gradually shifted from technology-oriented perspectives toward more experience-centered approaches. Virtual avatars are no longer regarded merely as information delivery tools but increasingly function as interactive mediators that facilitate cultural communication and enhance engagement and immersion. These developments highlight the growing importance of virtual avatars in supporting digital heritage interpretation and improving museum experiences.

Despite these contributions, several limitations should be acknowledged. This review focused on English-language studies published between 2021 and 2026 and was limited to literature indexed in major databases. Future research may extend the scope of databases and cultural contexts, examine long-term user experiences, and develop integrative frameworks to explain the combined effects of multiple avatar characteristics. In addition, emerging technologies such as generative artificial intelligence and multimodal interaction are expected to provide new opportunities for virtual avatar applications in digital heritage environments.

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