

Article

AI Avatar Storytelling as a Mediator of Visual Folk Heritage in Early Childhood Education

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Abstract

This paper presents the design and pedagogical rationale of an AI-powered avatar developed to mediate Cypriot woven heritage for preschool education. The study is conceptual and design-oriented, focusing on how visual motifs from Cypriot traditional weaving can be reinterpreted through an LLM-based conversational system grounded in retrieval-augmented generation (RAG). The system, named Sophia, transforms textile patterns from the *fythiotiko* tradition into dialogic narrative prompts that support storytelling, visual exploration, and creative expression in early childhood contexts. The proposed framework is intended to illustrate how artificial intelligence can support the reinterpretation of cultural artifacts as pedagogical resources when embedded within guided-play and museum-based learning approaches. It integrates visual analysis, dialogic storytelling, and artmaking into a structured learning sequence that moves from observation to interpretation and creative transformation. Rather than claiming empirical outcomes, the study positions AI-supported storytelling as a design hypothesis for culturally responsive early childhood education. It argues that AI systems can function as mediational tools between material heritage and children's imaginative engagement, provided they are developed with pedagogical intentionality, cultural sensitivity, and ethical oversight. The paper concludes by outlining design principles for implementing AI-driven storytelling systems in museums and classroom contexts and identifies the need for future empirical validation in real educational settings.

Keywords: artificial intelligence; AI avatar; cultural heritage; museum education; digital storytelling; early childhood education; traditional weaving; human–AI interaction



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1. Introduction

Folk culture constitutes a foundational dimension of cultural identity, encompassing oral narratives, material practices, symbolic representations, and aesthetic expressions that are transmitted across generations. These cultural forms not only preserve collective memory, but also shape how individuals interpret and engage with the world. At the same time, for folk culture to remain meaningful, it must undergo processes of adaptation in response to shifting social, technological, and cultural contexts [1,2]. This dynamic

interplay between continuity and change positions folk traditions not as static relics of the past, but as evolving systems that require ongoing reinterpretation, particularly within educational settings.

Museums have increasingly been recognized as critical sites for mediating this relationship between heritage and contemporary experience. Within the framework of critical and participatory museology, museums are no longer conceived as passive repositories of objects, but as interactive environments that foster dialogue, interpretation, and engagement [1,3]. In this context, storytelling has emerged as a powerful pedagogical strategy, enabling preschool learners to connect with cultural artifacts through narrative structures that promote imagination, emotional engagement, and meaning-making. Research indicates that narrative-based approaches in museum education can significantly enhance children's participation and support deeper cognitive and social engagement with cultural content [3].

Despite these developments, a significant gap remains in early childhood education research and practice. Although the educational value of folk culture and museum-based learning is widely recognized, existing studies have largely remained descriptive or theoretical, with limited emphasis on the systematic design and evaluation of pedagogical interventions [4]. Consequently, there is a shortage of applied, design-oriented approaches that demonstrate how specific instructional or creative frameworks can effectively transform traditional cultural material into developmentally appropriate learning experiences for young children [2,5,6]. This underscores the need for coherent, practice-oriented models that bridge theoretical insights with educational implementation, as well as the need for stronger frameworks connecting heritage content with learning processes [7].

Furthermore, although digital technologies are increasingly integrated into educational environments [8], their use in heritage education, particularly through artificial intelligence (AI), remains unexplored, especially in ways that prioritize creativity, cultural authenticity, and active participation over passive consumption. Recent advances in artificial intelligence offer new possibilities for addressing this gap. AI-supported storytelling systems, including interactive avatars and co-creative narrative tools, have demonstrated potential to enhance children's narrative development, creativity, and engagement by enabling dynamic, multi-modal interactions [9–11]. Such technologies can function as mediators between children and cultural content, transforming static artifacts into interactive story worlds that invite exploration and reinterpretation. However, the integration of AI in early childhood and cultural education also raises important questions regarding accessibility, inclusivity, and ethical design, highlighting the need for pedagogically grounded and culturally sensitive implementations [12].

Within this context, the present study introduces the design and pedagogical rationale of an AI-powered avatar developed to facilitate storytelling for preschool children, based on patterns derived from traditional Cypriot weaving. The project focused on a woven textile selected from the Cyprus Folk Art Museum, conceptualized as a visual repository of cultural memory in which patterns encode social, symbolic, and aesthetic meanings. Through the use of storytelling, the avatar transforms these visual elements into narrative experiences that are accessible and meaningful for young learners.

Drawing on theories of play-based learning, museum education, and heritage transformation, the study argues that AI-supported storytelling can function not as a substitute for tradition, but as a bridge between historical material culture and children's contemporary lived experiences. By integrating visual pattern recognition, narrative construction, and participatory interaction, the proposed model is intended to demonstrate how digital tools can support culturally grounded, inclusive, and developmentally meaningful learning. The proposed framework suggests that AI-supported storytelling may offer a conceptual

pathway for enhancing children's engagement with cultural heritage, although empirical validation is required in future studies.

2. Playfulness and Storytelling in Early Childhood Education

Early childhood represents a crucial stage for the development of symbolic and cognitive thinking. During this period, children begin to interpret reality through imagination, play, and storytelling. Their thinking does not yet take the form of abstract and formal-logical reasoning; rather, it predominantly assumes a narrative and symbolic structure through which children organize their experiences and attribute meaning to the world around them [13,14]. Learning at this stage is closely linked to emotional involvement and meaning-making, as children do not passively receive knowledge, but actively construct it through experience, interaction with their environment, and participation in the cultural practices that surround them [15]. From this perspective, storytelling and play are central cognitive and relational tools, enabling children to explore possible scenarios, rework lived experiences, and gradually build their identity within shared cultural contexts [13,16].

Within this developmental framework, narrative competence emerges as a key dimension of learning, self-construction, and social relationships [17]. As Bruner [13] argues, human thought is fundamentally structured in narrative form, making storytelling a primary cognitive means through which individuals interpret reality and make sense of experience. In early childhood, this process is particularly evident, as children rely on stories to organize events, understand emotions, interpret social relationships, and recognize the intentions of others. Likewise, Smorti [14] emphasizes the role of narrative thinking in the development of social knowledge, showing how children construct coherent and meaningful representations of reality through narrative frameworks. Storytelling thus becomes a privileged context for developing temporal and causal understanding, fostering essential competences for engaging with the social world.

Narrative also plays an important role in identity construction. By recounting their experiences, children begin to create continuity and meaning within their personal histories, integrating emotions and lived events into a coherent structure [18]. Storytelling, therefore, is not merely descriptive but genuinely formative, as identity is actively constructed through acts of narration. This perspective is reflected in early childhood educational settings, where narrative activities promote self-awareness, personal expression, and social competence [16]. Through the sharing of stories, children negotiate meanings, co-construct collective understandings, and participate in relational forms of learning. Moreover, research indicates that narrative competence does not develop uniformly or spontaneously; rather, it can be strengthened through targeted educational interventions. Scaffolding strategies and structured storytelling activities support the development of narrative coherence, organization, and cohesion in preschool children, generating positive effects on language development and emergent literacy [17,19].

Alongside storytelling, play constitutes another fundamental dimension of early childhood education. From a constructivist perspective, play is far more than a form of entertainment; it represents a primary epistemological tool through which children explore, interpret, and construct reality. As Dewey [15] argues, early learning is grounded in experience, and play provides one of the most authentic contexts in which experience is transformed into knowledge. Yet, experience becomes genuinely educational only when it is characterized by active engagement, continuity, and personal meaning. Under these conditions, play emerges as a privileged space where experience and learning are deeply interconnected.

From a cognitive standpoint, Piaget [20] conceives play as a process through which children assimilate reality into existing mental schemas and actively reorganize it. Symbolic

play, in particular, enables children to transform objects and situations into mental representations, thereby fostering symbolic thought and the gradual emergence of abstraction. Complementing this view, Vygotsky [21] argues that imaginative play allows children to create “imaginary situations” in which they move beyond the limits of immediate reality by enacting roles, rules, and shared symbolic meanings. Through these activities, children internalize cultural norms, develop self-regulation, and acquire increasingly complex cognitive tools. Taken together, these perspectives position play as a developmental and cultural space in which children represent, reinterpret, and transform the world, opening new possibilities for understanding. This transformative view is further supported by Caillois [22], who describes play as an autonomous symbolic space, distinct from ordinary reality and governed by its own conventions, where new interpretations can be explored freely.

In his seminal study, the French sociologist, Roger Caillois, proposes not a tripartite, but a fourfold taxonomy of play, structured around what he identifies as the fundamental impulses underlying ludic experience [22]. The first category, *Agon*, designates forms of play grounded in competition, discipline, and the demonstration of skill within regulated conditions of equality; it is the principle that underlies competitive games such as chess, football, or tennis, and which, in the context of educational video games, may foster motivation, perseverance, and problem-solving through systems of challenge and achievement. *Alea*, by contrast, refers to games governed by chance, where the player relinquishes agency to fate and uncertainty, as in dice games, lotteries, or roulette; within pedagogical game design, controlled elements of randomness may contribute to engagement, adaptability, and the capacity to respond to unpredictable scenarios. The category of *Mimicry* encompasses simulation, imitation, and role assumption, inviting players to inhabit fictional identities or alternative realities, as occurs in theatre, masquerade, or role-playing games. This dimension is particularly significant for educational video games, insofar as immersive simulation can encourage empathy, situated learning, and experiential understanding through narrative participation. Lastly, *Ilinx* identifies forms of play that seek to destabilize ordinary perception by inducing sensations of vertigo, exhilaration, or sensory disorientation, exemplified by spinning rides or roller coasters. Although less immediately associated with educational aims, this dimension remains relevant in contemporary digital environments, where sensory immersion and embodied interaction may intensify emotional involvement and cognitive engagement. Together, Caillois’ four categories offer a valuable conceptual framework for understanding how educational video games (edugames) mobilize different structures of play to support learning, motivation, and experiential participation. Although originally developed for games, Caillois’ taxonomy is here reinterpreted as an analytical lens for understanding interaction modalities in AI-mediated narrative environments rather than as a direct mapping to gameplay mechanics.

Within this theoretical tradition, Gianni Rodari [23] assigns a central role to imagination in cognitive development, arguing that play and storytelling enable children to creatively rework reality and establish new connections of meaning. For Rodari, imagination is not opposed to rational thought but constitutes an essential mode of knowing, through which children explore possibilities and generate alternative interpretations of the world. Contemporary research reinforces this perspective by demonstrating that play supports engagement, motivation, and the development of cognitive, social, and emotional competences in early childhood. Elly [24], for example, identifies pleasure, freedom, and active participation as essential conditions for the shared construction of meaning in educational settings. Likewise, empirical studies indicate that game-based learning promotes deeper and more lasting learning, while supporting thinking, creativity, and participation [25,26]. Within this framework, the concept of guided play proposed by Weisberg et al. [27] is particularly relevant because it moves beyond the opposition between free play

and structured instruction. According to this perspective, the most effective educational contexts combine children's autonomous initiative with intentional adult guidance. The educator thus assumes the role of facilitator, designing rich and meaningful contexts in which play and storytelling work together to support active knowledge construction.

If play and storytelling are fundamental means through which children construct and reinterpret meaning, storytelling also performs an additional mediational function by connecting children's present experience with cultural heritage. It makes contents from distant times and contexts more accessible. In line with Rodari's [23] pedagogical vision, imagination enables children to engage creatively with cultural contents, transforming transmission into active reinterpretation. His well-known question—whether a child should learn through tears what could be learned through laughter—captures the essence of a playful, imaginative, and creative conception of education that anticipates later reflections on lateral thinking and creative problem-solving [28,29]. Storytelling, therefore, extends beyond the mere communication of information, creating opportunities for children to encounter and appropriate cultural heritage through active participation.

Recent technological developments have expanded the mediational potential of storytelling. Digital storytelling may be understood as a multimodal practice that integrates images, sounds, text, and animation to create immersive and accessible narrative experiences [30,31]. These characteristics are particularly relevant in early childhood education because they allow cultural contents to be adapted to children's modes of learning and support more personalized educational pathways. In museum contexts, digital storytelling has proved effective in making cultural heritage more accessible to diverse audiences and fostering deeper forms of engagement [32]. Even when cultural contents are complex, it can support deeper learning and foster a sense of belonging and connection to place [33,34]. Other innovative approaches that integrate virtual and augmented reality with interactive environments further transform cultural heritage into dynamic educational experiences. Museums thus become increasingly inclusive and participatory spaces in which children actively contribute to processes of meaning-making rather than merely consuming information [35,36]. Recent studies show that integrating storytelling with mobile technologies enhances children's interest in cultural heritage and facilitates meaningful connections between past and present [37].

Taken together, these perspectives highlight the close interrelationship between play, storytelling, and cultural learning. Their integration with digital technologies creates opportunities for meaningful educational experiences from early childhood, fostering cultural awareness, strengthening a sense of belonging, and promoting children's active participation in the social and territorial contexts in which they live.

3. AI Avatars and the Digital Mediation of Heritage

In recent decades, museums have progressively incorporated interactive and digital practices capable of transforming preschool learners from passive observers into active participants within processes of knowledge construction. Museum institutions have long played a central role in the transmission, enhancement, and preservation of cultural heritage, establishing themselves as key sites in which the educational, symbolic, and cognitive practices of a community are shaped. To understand their epistemological significance more fully, it is useful to consider the etymology of the term *museum*. The word derives from the Greek *mouseion* (μουσεῖον), which originally referred to a temple or sanctuary dedicated to the Muses and, by extension, to a space devoted to the practice and study of the arts. As documented in classical lexicography, this meaning encompasses both sacred and educational dimensions, establishing an early connection between artistic inspiration and pedagogical function [36]. During the Latin period, the term *museum* retained its

symbolic association with the Muses as figures linked to poetic and artistic creation. In this way, the museum gradually came to be understood as a privileged locus for the production and transmission of knowledge.

Over the centuries, museum institutions have undergone a complex evolution in response to historical, political, and cultural transformations. Initially characterized by an elite dimension tied to private collections, the museum progressively emerged as a public institution between the nineteenth and twentieth centuries, assuming an increasingly formalised educational and civic role. The twentieth century marked a further transformation. As museums adapted to the dynamics of modern culture, they promoted broader cultural awareness and strengthened their role as centers of scientific research and knowledge production. This process is also reflected in exhibition practices, which evolved toward systematic architectural and museographical solutions designed to guide preschool learners along logical and narrative pathways, thereby encouraging conscious and multilayered engagement with displayed content [36].

Today, the museum is no longer conceived as a static space, but as a dynamic and narrative environment in which storytelling plays a central role. This evolution has transformed museums into visitor-centered institutions grounded in experience and active participation. Through the narrative organization of artworks and artifacts, museums engage young visitors' sensibilities in ways that go beyond the simple transmission of historical or artistic information. Instead, they create interpretative pathways that stimulate cognitive engagement, allowing young visitors to move from passive observers to active participants who interpret and reconfigure meaning [38,39]. As a result, museums can no longer be understood merely as spaces for conservation and display. They are increasingly open, inclusive, and participatory environments. Within this context, the concept of accessibility has expanded beyond physical access to include cognitive, sensory, and digital dimensions. The integration of emerging technologies, ranging from virtual reality to generative artificial intelligence and avatar-based systems, has significantly enriched the visitor experience by creating multisensory environments that support deeper understanding [40]. Among these innovations, artificial intelligence stands out for its potential, provided its use is guided by shared ethical principles. Its integration into educational contexts represents a complex and urgent challenge that requires approaches capable of addressing the inherent complexity of contemporary learning processes. The concept of "simplicity" offers a useful framework in this regard, as it discourages passive reliance on automation while promoting the development of metacognitive skills that enable users to critically interpret information [41]. Within this perspective, AI can support personalized and reflective learning experiences, particularly when users are given some understanding of how algorithmic systems operate. A concrete example is the use of Digital Personal Tutors, systems designed to guide visitors through personalized pathways by adapting content, language, and levels of complexity to individual needs [1]. However, from a simplicity perspective, such tools do not replace human mediation. Instead, they form part of a broader educational design in which educators and museum mediators retain responsibility for guiding learning processes and critically selecting content [41]. The effectiveness of integrating digital technologies into museum education ultimately depends on careful strategic planning. This includes aligning technological choices with institutional contexts and educational objectives. To be effective, digital tools should fulfil three key functions: they should act as boundary devices that connect diverse visitor perspectives and support the co-construction of meaning; be highly adaptable to different learning needs and cognitive styles; and facilitate flexible and accessible engagement with collections, ensuring that museum experiences remain meaningful, relevant, and stimulating for all visitors [42,43]. When considered from this standpoint, applications of augmented reality illustrate the

transformative potential of digital mediation in cultural heritage contexts. By overlaying historical reconstructions onto physical sites, these technologies enable a dynamic dialogue between past and present. They position the museum as an active learning environment in which shifts in modes of observation lead to genuine changes in perspective [44–46]. Such approaches encourage participatory engagement, prompting visitors to explore, question, and construct their own critical understanding of the world [47]. Technology thus emerges as a key mediating force between past and future, opening new possibilities for accessing, interpreting, and transmitting cultural heritage [48].

4. The Case Study: Designing the AI Avatar “Sophia”

Situated within the broader framework of ludic pedagogy outlined in the previous sections, the present case study introduces the role of Non-Player Characters (NPCs) in educational and virtual environments. This perspective highlights the pedagogical principles underpinning the development of the Sophia avatar. In educational settings, the use of digital resources such as videos, three-dimensional models, and interactive content mediated by NPCs significantly expands learning opportunities. Within this context, NPCs function as didactic mediators capable of adapting content, language, and communication strategies to learners’ characteristics and specific contexts. In virtual museum environments, the NPC assumes the role of an interactive guide. Rather than simply delivering information, the agent constructs contextualized narratives and responds to user queries, adjusting the level of depth according to individual competencies. In this way, the experience becomes accessible to diverse audiences. Based on these premises, the project is structured into three operational phases: the selection of the textile artefact, the translation of patterns into narrative elements, and the definition of the avatar’s personality, tone of voice, and interaction design. These phases enable an overall evaluation of the effectiveness of the pedagogical framework.

4.1. Selection of the Woven Artefact

The first phase of the design process concerns the identification and selection of the reference textile artefact, namely the *fythiotiko*, from the craft tradition of the village of Fyti [49] in Cyprus. This choice is motivated by the artefact’s high cultural value. Through its *ploumià*, decorative motifs created by weaving threads of different types on a horizontal loom, the *fythiotiko* embodies both material and immaterial cultural dimensions. These features make it particularly suitable for narrative mediation and for its translation into an immersive digital environment.

4.2. Translating Patterns into Narrative Elements

The second phase involves the transformation of the ornamental patterns of the *fythiotiko* into narrative structures. The compositional logic of the *ploumià*, based on repetition, symmetry, and variation, is reinterpreted as a generative narrative device. In this process, textile elements are reconceptualized as narrative categories, establishing a connection between visual form and cultural meaning. The textile pattern thus becomes a visual grammar of narration, capable of activating interpretive processes and fostering active meaning-making by the user.

Table 1 presents a structured interpretive framework that translates selected motifs from Cypriot *fythiotiko* weaving into narrative categories for use in AI-mediated storytelling. The motif selection and structural interpretation of *fythiotiko* weaving is based on the documented analyses of Astreou-Christoforou [50], who identifies *ploumià* as a key expressive system of Cypriot textile semiotics, combining repetition, symmetry, and chromatic rhythm to encode cultural memory. Table 1 operationalizes the central design

principles of the study, that visual folk patterns can function as semiotic systems capable of generating story elements when reinterpreted through pedagogical mediation. Each row identifies a specific textile motif and links it to three analytical dimensions: structural features, narrative interpretation, story function in narrative construction. The structural features of the motifs describe the visual grammar of the weaving tradition, including symmetry, repetition, directionality, rhythm, and compositional framing. These features reflect the underlying logic of the *fythiotiko* textile design, where meaning is embedded not through figurative representation but through abstract geometric organization. The narrative interpretation translates visual structures into culturally grounded narrative affordances. For example, repetition is interpreted as “memory of village life”, while directional zigzag patterns are associated with “journey or transformation”. These interpretations are not fixed iconographic meanings but generative hypotheses used to support storytelling within the avatar system. The story function in narrative construction dimension positions each motif within a story grammar framework (e.g., character, setting, temporal structure, event, or narrative frame). In this way, textile elements become functional components of emergent story worlds co-constructed between the AI avatar and the child. Overall, the table demonstrates how material cultural artifacts can be reconfigured into pedagogical narrative scaffolds. The mapping is intentionally interpretive rather than deterministic, allowing multiple narrative pathways to emerge through dialogic interactions.

Table 1. Translation of Textile Motifs into Narrative Categories.

Textile Motif (Fythiotiko)	Structural Feature	Narrative Interpretation	Story Function
Repeating diamond pattern 	Symmetry and repetition	Memory of village life	Setting/cultural space
Zigzag horizontal line 	Directional movement	River/journey motif	Event/transformation
Central geometric form 	Visual dominance	Character or guardian figure	Protagonist
Alternating color bands 	Rhythm variation	Passage of time, seasons, cycles	Temporal structure
Enclosed border pattern 	Boundary framing	Protection, threshold, entry/exit of story world	Narrative frame

4.3. Avatar Personality, Voice, and Interaction Design

The third phase focuses on the design of the educational avatar Sophia, defining the technological, narrative, and pedagogical aspects that structure its behavior and interaction modes. The system is implemented using Unity 3D and Convai integration, combining a large language model (LLM) with a Retrieval-Augmented Generation (RAG) architecture. The specific base model is not fine-tuned for this study; instead, prompting strategies and curated knowledge retrieval are used to guide response generation. Speech interaction is supported through automatic speech recognition (ASR) and text-to-speech (TTS) systems. While ASR enables multimodal engagement, its performance when processing preschool children's speech is variable and constitutes a known limitation of the system.

This approach enhances informational reliability and reduces the risk of inaccurate or unverified outputs [51–54]. Interaction with Sophia is multimodal and occurs through both textual and vocal channels (ASR and TTS technologies). The avatar functions as a tool for cultural mediation and narrative guidance, adopting a dialogic approach that encourages active participation. In particular, the use of open-ended questions promotes reflection and supports user engagement. Within an inclusive pedagogical framework, this design enables the integration of compensatory tools for students with special educational needs, particularly those with dyslexia, promoting self-regulated learning and metacognitive reflection through interactive question–answer dynamics [47,55]. Narrative components are not ancillary but constitutive of the interaction: stories operate as cognitive and cultural devices through which users organize and attribute meaning to experience, facilitating both the processing of complex content and the promotion of cognitive and emotional engagement [56]. In the museum setting, Sophia performs a dual function both as a virtual guide and as an institutional ambassador. It ensures interactive, accessible, and multilingual communication (English, Greek, and Italian), enabling the contextualized and adaptive dissemination of cultural content and reinforcing the museum's educational mission (see Figure 1).



Figure 1. Sophia answers in Greek to a preschool learner's question in the virtual museum.

Note: Sophia’s translation: Welcome to the Cyprus Folk Art Museum! This special place is full of stories about the traditions and history of Cyprus. Here you can discover beautiful traditional costumes, colourful embroidered textiles, handwoven fabrics, old household objects, and tools that people used in their everyday lives long ago.

This design approach is consistent with recent developments in educational computing and media-based learning systems, which emphasize that effective human–machine interaction relies on activating generative cognitive processes, such as selecting relevant information, organizing it into coherent structures, and integrating it with prior knowledge [57]. Accordingly, Sophia is designed to reduce extraneous cognitive load and minimize processing that does not contribute to instructional goals, while fostering deeper, meaning-oriented learning (Figure 2). From a pedagogical perspective, interaction with Sophia can be understood as a progressive pathway structured across three levels of cognitive complexity: informative, interpretative, and exploratory. These levels are not strictly sequential but operate as interconnected modes of engagement. Together, they contribute to increased social presence and telepresence—factors associated with sustained attention and higher intrinsic motivation in digitally mediated learning environments [54,58].



Figure 2. The figure illustrates the avatar Sophia inside the virtual museum. In the background, it is also possible to observe the traditional Cypriot blanket, made using the art of *fythiotiko*.

Table 2 illustrates representative dialogue examples corresponding to the three cognitive levels implemented in Sophia. The informative level focuses on observation and factual recognition of visual features; the interpretative level encourages children to attribute symbolic meaning to the textile motifs; and the exploratory level supports collaborative story creation through open-ended narrative prompts. These examples illustrate the intended interaction design and demonstrate how guided dialogue progressively scaffolds children’s observation, interpretation, and imaginative participation. The three cognitive levels are not strictly sequential but are dynamically combined according to the child’s responses, prior knowledge, and educator guidance.

Table 2. Cognitive Interaction Levels in Sophia.

Cognitive Level	Pedagogical Objective	Illustrative Dialogue	Educational Function
Informative	To promote observation and recognition of visual features in the woven artefact.	Sophia: “This woven pattern is called <i>ploumià</i> . What shapes can you see?” Child: “I see diamonds.” Sophia: “That’s right. The repeating diamond shapes are one of the characteristic motifs of this textile.”	Supports visual literacy, vocabulary development, focused observation, and recognition of patterns before introducing interpretation.
Interpretative	To encourage symbolic thinking by connecting visual motifs with possible meanings.	Sophia: “What do you think these repeating diamonds could represent?” Child: “Maybe little houses.” Sophia: “That is a wonderful idea. They could become the homes of the people in our story.”	Encourages inference, symbolic interpretation, dialogic reasoning, and the co-construction of meaning through guided conversation.
Exploratory	To foster imagination, creativity, and collaborative storytelling.	Sophia: “If these houses belonged to a magical village, who might live there?” Child: “A little guardian who protects everyone.” Sophia: “Wonderful! Let’s imagine what happens when the guardian discovers a secret hidden inside the woven pattern.”	Promotes narrative construction, creative expression, role-taking, and collaborative story development within a guided-play framework.

4.4. Ethical, Safeguarding, and Data Governance Considerations

The design of Sophia is informed by ethical considerations related to the use of generative AI in early childhood educational contexts. Given the target age group (3–6 years), the system is intended to operate under the continuous supervision of an educator rather than as an autonomous learning agent. All interactions are assumed to occur within structured educational environments (museum or classroom settings) where informed parental consent and institutional approval are required prior to use. The system does not store or retain personal data from child users, and interaction data are processed anonymously and used only transiently within the scope of the prototype design.

To mitigate risks associated with generative AI outputs, Sophia is designed with retrieval-augmented generation (RAG), ensuring that responses are grounded in a curated cultural corpus. The knowledge base consists exclusively of academic books, scholarly publications, and validated educational resources that were manually selected and incorporated into the system’s database [50]. Consequently, the avatar generates narratives and explanations based on reliable and culturally authentic sources rather than open-ended internet content.

As part of the prototype evaluation, Sophia was prompted to create stories inspired by traditional Cypriot textiles, including the *fythkiotiko* weaving tradition. The generated narratives were specifically designed to be developmentally appropriate for children aged 3–6 years, employing simple language, culturally meaningful themes, and age-appropriate storytelling structures.

However, the system may still produce unpredictable outputs; therefore, educators are expected to mediate interactions and validate content during use. No autonomous decision-making is performed by the system, and it is not intended to function as a replacement for human pedagogical judgment. These constraints reflect a precautionary design stance aligned with emerging guidelines for child-facing AI systems in educational contexts. Future implementations should include formal data protection impact assessments (DPIA), structured consent workflows, and explicit auditing of content safety mechanisms.

5. From Pattern to Story World: Educational Implementation

The educational implementation of the AI avatar *Sophia* was conceived as a pedagogical framework for translating the visual grammar of Cypriot traditional weaving into developmentally appropriate storytelling and artmaking experiences for preschool children. Building upon the theoretical foundations outlined in the preceding sections, the model repositions woven patterns not merely as an object of visual observation, but as a semiotic and narrative catalyst through which children may engage in interpretive, imaginative, and creative meaning-making. In this approach, the *fythiotiko* textile functions as the point of departure for a structured learning sequence in which children progress from visual analysis to narrative construction and subsequently to artistic reinterpretation. The objective is not limited to the transmission of heritage knowledge. Rather, it is to activate children's imaginative capacities and foster dialogic engagement with cultural material through mediated narrative interaction. The first stage of the educational pathway involves pattern exploration, during which children are introduced to the selected woven textile through observation and discussion facilitated by the avatar. Drawing on principles of slow looking [2,59] and dialogic museum pedagogy [60,61], Sophia prompts children to attend closely to the textile's motifs, colors, repetitions, symmetries, and compositional structures. Within this framework, slow looking is understood as a process of sustained, focused observation that supports reflective meaning-making, while dialogic pedagogy foregrounds interpretive exchange, encouraging children to recognize the multiplicity of possible meanings and to engage with visual material as an open field of shared inquiry [2]. Rather than transmitting predetermined iconographic interpretations, the avatar encourages speculative inquiry by inviting children to identify visual forms and imagine what they signify. In doing so, the textile is framed as an open symbolic system whose meanings emerge through interpretive engagement. The avatar invites multiple possibilities, positioning the patterns as open symbolic forms capable of generating multiple interpretations. This initial stage supports visual literacy, observational competence, and symbolic thinking, while reconstituting the museum woven artefact as an active site of narrative possibility. The second stage consists of narrative mediation through storytelling, whereby the observed textile motifs are transformed into elements of an emergent story world. Through scripted yet adaptive dialogue, Sophia introduces the woven textile as a "map of stories" woven by people of the past, suggesting that each motif may conceal a character, place, creature, or event from imagined or historical worlds. In this sense, the avatar functions as a mediating narrative agent between artifact and child, translating visual abstraction into age-appropriate narrative prompts. The storytelling process is intentionally dialogic, as children are invited to predict events, infer meanings, propose alternative interpretations, and contribute to the unfolding narrative. Such interaction shifts children from passive recipients of information to active co-constructors of the story world. To further enhance participation, children may engage in role-taking, narrative branching, and story continuation activities, whereby they assume character perspectives, make decisions that influence narrative progression, and co-author extensions of the emerging story world. This pedagogical structure aligns with constructivist and guided-play approaches, according to which learning is optimized when exploratory autonomy is scaffolded through intentional mediation [62,63]. The third stage emphasizes creative reinterpretation through artmaking, in which children respond to the collaboratively generated story world by producing their own visual and narrative compositions. Drawing inspiration from the traditional motifs encountered through the avatar-mediated storytelling process, children create contemporary patterns and associated narratives using media such as drawing, collage, weaving, or mixed techniques. Crucially, the educational intention is not the replication of heritage forms, but their reinterpretation through the lens of children's own identities, experiences, and social worlds. In this sense,

traditional folk art functions as a conceptual springboard rather than a prescriptive model, enabling children to bridge cultural heritage to their contemporary lives through imaginative transformation. To ensure pedagogical coherence, the implementation model is organized around three interrelated educational aims: heritage understanding, narrative development, and creative expression. First, children cultivate foundational awareness of cultural heritage by engaging with the textile as a historically situated artefact embedded in social and material traditions. Second, they develop narrative competence through collaborative storytelling practices that require sequencing, symbolic interpretation, causal reasoning, and dialogic participation. Third, they strengthen creative and reflective capacities by transforming inherited visual structures into original artistic productions. In this respect, the implementation situates itself at the intersection of museum education, arts-based pedagogy, and digital storytelling. The model further incorporates principles of inclusive and multimodal educational design. Through the integration of voice, text, gesture, and visual prompts, Sophia accommodates diverse sensory, linguistic, and cognitive learning profiles, thereby broadening accessibility within heritage education contexts [64]. The multimodal nature of the interaction allows educators to adapt the experience across developmental stages and instructional settings, including museums, classrooms, and hybrid learning environments. In addition, the avatar's capacity to operate across multiple languages, including English, Greek, and Italian, enhances linguistic accessibility and supports participation among children from diverse language backgrounds, while also enabling cross-cultural engagement with the learning material. Moreover, by grounding AI-generated outputs in a curated corpus of validated cultural material while preserving interpretive openness in narrative elaboration, the system negotiates the tension between cultural authenticity and creative flexibility. The transition from pattern to story world operationalizes the central pedagogical premise of the study: that traditional cultural artifacts can become meaningful educational resources when reinterpreted through narrative, play, and digital mediation. Through the structured yet imaginative interaction facilitated by Sophia, preschool children are invited not only to learn about folk heritage, but to enter into dialogue with it, reimagining inherited forms through storytelling and transforming them into new expressions of personal and collective meaning. In doing so, the proposed design is intended to demonstrate the capacity of AI-supported storytelling to foster educational encounters with heritage that are participatory, inclusive, developmentally appropriate, and responsive to contemporary educational contexts.

6. Conclusions

This study presented the design and pedagogical rationale of Sophia, an AI-powered educational avatar developed as a conceptual model for mediating Cypriot woven heritage through storytelling in early childhood education. By translating visual motifs derived from the *fythiotiko* textile into interactive narrative structures using an LLM-based architecture grounded in retrieval-augmented generation, the framework illustrates how artificial intelligence can be designed to reinterpret traditional cultural artifacts as meaningful educational resources.

The proposed model suggests that AI-supported storytelling may function as an effective mediational bridge between historical material culture and young children's contemporary modes of learning when embedded within a pedagogically grounded framework. Specifically, the integration of visual analysis, dialogic storytelling, and creative artmaking is intended to enable heritage objects to move beyond passive observation and become catalysts for narrative thinking, imaginative engagement, creative expression, and personal meaning-making. In this respect, the study contributes to ongoing discussions in

heritage education by offering a concrete design-oriented model for translating visual folk culture into participatory early childhood learning experiences.

At the same time, the study emphasizes that AI should not be understood as a substitute for human mediation or established pedagogical practice, but rather as a complementary interpretive tool whose educational value depends on intentional design, cultural sensitivity, ethical implementation, and the quality of curated cultural content. Likewise, the effectiveness of AI-supported heritage learning remains closely connected to the pedagogical structure of interaction, and the active role of educators in scaffolding children's observation, interpretation, dialogue, and reflection.

As a conceptual and design-based study, the present work does not provide empirical evidence of learning outcomes or user experience. Consequently, the proposed framework should be understood as a theoretically grounded design model that requires validation in authentic educational contexts. Future research should investigate the implementation of AI-mediated heritage storytelling in museums and preschool classrooms, examining its effects on children's narrative development, cultural understanding, creative expression, engagement, and inclusion. Additional studies should also explore the adaptability of this approach across different cultural traditions, museum collections, and multilingual learning environments, while further examining ethical safeguards, child-centered AI design, and responsible data governance.

Overall, this work argues that the meaningful integration of artificial intelligence into heritage education has the potential to expand the interpretive possibilities of museum artifacts and contribute to more accessible, participatory, culturally responsive, and future-oriented forms of cultural transmission.

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