Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
Special Issue on Digital Preservation and Intelligent Innovation in Traditional and Modern Arts 7(1s)

EDUCATIONAL GAMES PROMOTING FOLK CULTURE THROUGH AI

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Received 10 September 2025
Accepted 07 December 2025
Published 17 February 2026

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DOI
10.29121/shodhkosh.v7.i1s.2026.7163

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

The globalization and the loss of intergenerational transmission are rapidly increasing, which poses a threat to the continuation of folk cultural traditions and necessitates interactive and scalable preservation systems. By combining artificial intelligence with learning game worlds, it is possible to create adaptive storytelling, multimodal cultural simulation, and customizable learning paths that can turn passive consumption of heritage into participatory cultural experience. An experimental architecture was developed based on a multilayer design of cultural knowledge graphs, intelligent AI services, gameplay interaction, and learning analytics that were experimentally tested using controlled learner studies. Quantitative findings indicate better normalized learning gain, better retention, better persistence of engagement, and high expert-validated cultural authenticity than non-adaptive digital learning resources. Semantic coherence and responsible cultural representation was achieved through knowledge-graph grounding and community validation. The results show that AI-based cultural games can be used as both pedagogical resources and living digital preservation ecosystems that can maintain long-term engagement with intangible heritage. Scalable multilingual implementation, immersive XR implementation, and privacy-preserving community-based learning models will continue to be the primary areas of the responsible AI-driven cultural education development.

Keywords: Artificial Intelligence, Educational Games, Folk Culture Preservation, Adaptive Learning, Cultural Heritage Informatics, Game-Based Learning

1. INTRODUCTION

The folk culture is the living practice of community knowledge in the form of oral narrative, music, dance, crafts, rituals, and seasonal practices that are developed both between generations. The traditions used to be largely based on the participatory transfer in families, festivals and local social organization systems instead of formal educational system Alam (2022). These cultural transmission pathways are now in decline due to the rapid urbanization, migration and the strength of digital entertainment that has led to fragmented regional identities and eventual erosion of intangible heritage. Sustainable preservation thus demands new learning spaces that can connect the younger generations and at the same time convey authenticity, context, and community relevancy. The interactive digital games offer immersive storytelling, problem-solving processes that are experiential and offer the learning processes that are emotional and no longer passive learning as seen in dry cultural archive stores Arztmann et al. (2022). The presence of an artificial intelligence makes it possible to engage in adaptive narration, procedural creation of cultural content and custom learning progression based on the background of the learner, language fluency, and cognitive speed Tlili et al. (2022). NLP assists in conversational retelling of myths and legends in the regional language, computer vision enables understanding of traditional symbols and clothes, and generative algorithms rebuild missing musical or artistic patterns based on fragmented information of the past Rizos et al. (2024). All this makes cultural learning participatory and active as opposed to a passive observation activity.

Figure 1

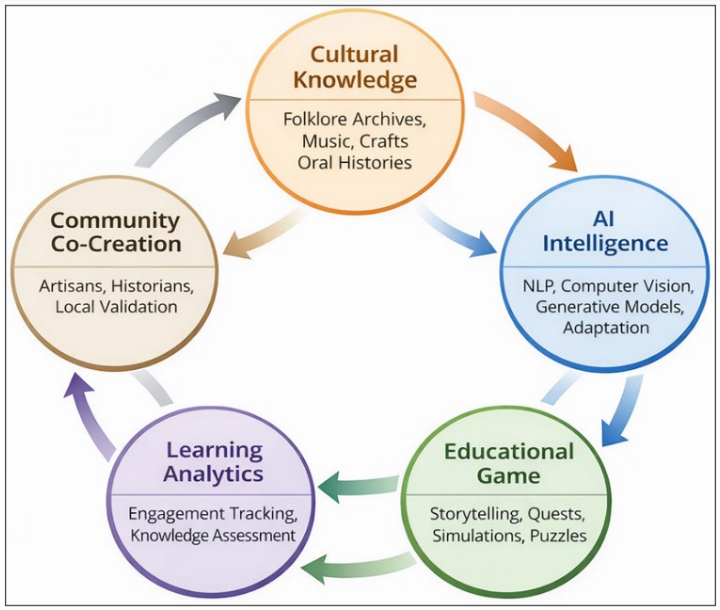

Figure 1 Conceptual Flow of AI-Driven Educational Games for Folk-Culture Learning

The existing digital heritage centers continue to be limited through reduced interactivity, lack of learner-related adjustment, and poor connectivity between culture depositories and education analytics. There is a lack of integrated technological system that links cultural knowledge representation Zdravkova (2022), smart control mechanisms, and quantifiable learning achievements within the AI-based educational studies as could be seen exemplified in Figure 1. The proposed allows the creation of scalable systems with an opportunity to revive intergenerational cultural exchange with intelligent game environments Antonova and Dankov (2023). The proposed direction creates a solution that combines an AI-enabled educational infrastructure (to serve as a conservation protocol, pedagogical medium, and community-authenticated cultural repository), which would lead to a long-term survival of folk traditions in changing digital communities.

2. AI-BASED CULTURAL EDUCATION

The scientific study of digital technologies in cultural learning has been developed in the areas of game-based education, heritage informatics, and intelligent tutoring systems and set a multidisciplinary groundwork of AI-assisted preservation of folk traditions Wang et al. (2023). The main interface of early cultural education was based on multimedia archives and rule-driven interactive communication based applications to offer descriptive access to folklores, music and crafts but failed to offer adaptive interaction or learner-centric personalization. Other studies later proposed the use of serious games and narrative simulation to increase motivation and experiential learning, showing better culture awareness and better memory in comparison to traditional instructional media Shehade and Stylianou-Lambert (2020). This has been changed considerably in artificial intelligence have made. Natural language processing is used to support conversational storytelling agents that can tell Myths and Oral histories using regional dialects, whereas computer vision is used to recognize common symbols, clothing styles and artistic traditions in interactive contexts Kaplan et al. (2023). Generative models also play a role by restoring cultural artifacts that have been cut up, synthesizing folk music style, and procedurally generated cultural settings that keep the learner interested in the learning process. However, despite these advancements, there are still deep-seated issues of concern over the validation of authenticity, the ethics-based sourcing of data, cultural representation bias, and the limited connection of learning analytics with heritage material U.S. Department of Education, Office of Educational Technology (2023). The literature in the field does not often provide a single framework relating cultural knowledge repository and AI intelligence, to adaptive gameplay and measurable learning outcomes. The reason behind filling this gap is to develop an integrated AI-based educational ecosystem that can be used to offer sustainability of culturally based learning in scalable digital worlds Duro et al. (2021).

3. KNOWLEDGE REPRESENTATION AND DATA SOURCES

The successful implementation of AI-based educational games on folk culture should rely on the accurate representation of knowledge and the identification of the credible source of cultural information. Folk traditions are fundamentally heterogenous with oral tales, musical ideas, performing arts, motif symbols, rituals, seasonal activities, and craft perpetuated mechanisms passed through the community memory and not in documentations Sun et al. (2021). To ensure that the content nevertheless carries the same meaning as when it was originally obtained, such intangible heritage must be systematically digitized, semantically organized, and contextually annotated so as to maintain its original meaning. Knowledge representation techniques usually incorporate multimodal cultural image libraries, which are text, audio, image, and video models. Oral folklore and myths are encoded and linguistically annotated to assist natural language processes Ferreiro-Seoane et al. (2022). The symbolic coding used to encode musical heritage includes symbolic notation, rhythm descriptors and spectral audio features which recognize patterns and generate musical pieces. The high-resolution imaging and metadata tagging of visual traditions such as textile motifs, paintings, and symbols used in rituals are used to classify them based on computer-vision and restore the style of reconstruction De Oliveira et al. (2022). Ontology-based metadata structures which maintain cultural relationships not isolated artifacts are used to preserve ethnographic context, such as geographic origin, community usage, festival association, and social meaning.

Figure 2

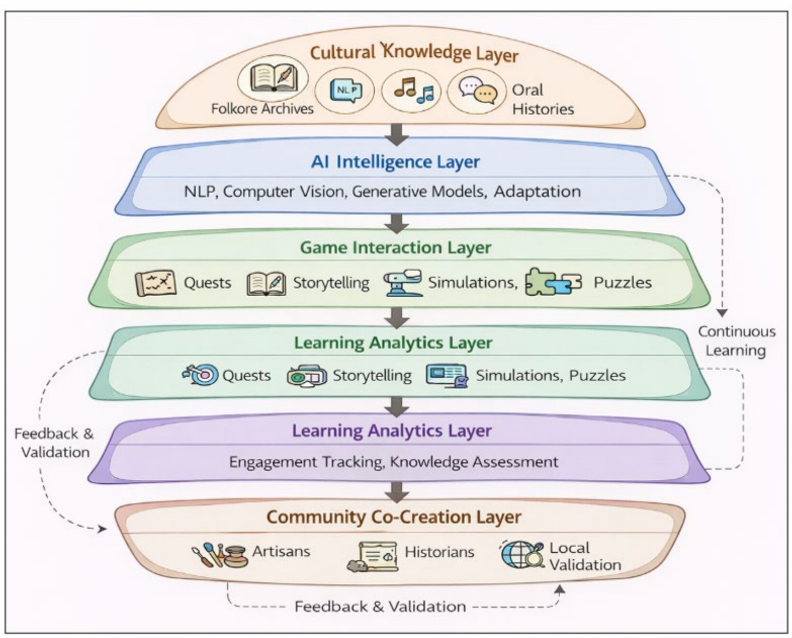

Figure 2 AI-Driven Folk Culture Learning Pipeline

Semantic technologies are the key in the organization of this knowledge. Cultural knowledge graphs and ontologies are structures that define the relationship between traditions, places, actors, instruments, stories, and historical periods to allow computer reasoning in the games. These types of representations enable the AI systems to construct culturally consistent scenes in real-time, such as by relating harvest-themed celebrations to local music, clothing, and farm rituals and supporting the immersion and contextually aware gameplay. Digital heritage standards and open cultural data frameworks interoperability also increases scalability and cross-regional integration as shown in Figure 2. The community-based and ethically-based approaches are needed to source data. Primary collection can include field recordings, interviews with artisans and storytellers, archival digitization and working with cultural institutions. Authenticity and misrepresentation are also blocked through validation by persons who possess the knowledge. Cultural ownership and responsible reuse in AI systems requires the use of licensing, attribution and consent mechanisms. Powerful knowledge representation with an ethical source of data can provide an infrastructure through which adaptive storytelling, generative cultural simulation, and analytics-driven learning assessment can go. It is on such infrastructure that preservation is not only allowed as a repository but as a vital, interactive cultural intelligence within the educational gameplay contexts.

4. AI MODELS FOR ADAPTIVE STORYTELLING AND CULTURAL SIMULATION

Educational games based on the folk-culture must employ adaptive storytelling in their approach which involves AI models that are capable of maintaining the narrative intent but flexible enough to cope with learner context by tailoring language, pace and content richness. A workable solution integrates retrieval augmented generation (RAG) and structured cultural knowledge to minimize the danger of hallucinations and ensure realness. These pipelines have a retriever (dense encoder or hybrid BM25+dense) that picks culturally grounded passages, myth variants, character archetypes, place references, proverbs, and ritual sequences, out of a curated repository or knowledge graph. Interactive narration with constrained retrieved evidence is created by a generator (transformer-based language model), and the parameters of reading level, dialect choice and episode length are controllable. Dialogue management layers save conversational state between turns with slot intent tracking (e.g., character, location, festival stage, moral dilemma), allowing the game to have many potential narratives which are semantically consistent quantities of dialogue. In the case of multilingual, the translation models and dialect adapters facilitate localized storytelling and the terminology constraints maintain culturally relevant named entities and ritual vocabulary without performing an over-normalization. Cultural simulation does not only deal with the text as it goes beyond that to encompass multimodal representations of music, crafts and rituals. Computer vision models (CNN and ViT backbones) are used to identify folk motifs, cloth structures, types of instruments, and aspects of clothing to play a game based on what they recognize, like identifying the pattern, matching parts of a picture to an object, or completing pattern pieces they have lost. Contrastive Contrastive mimicry as a metric-based learning objective brings about enhanced robustness in cases where training data are scarce or visually heterogeneous between areas.

Table 1

Table 1 AI Tasks, Model Families, and Cultural Authenticity Constraints

AI Task	Model Family	Typical Inputs / Outputs	Constraints for Cultural Authenticity
Adaptive narrative generation	Transformer-based LLM with retrieval augmentation	Input: folklore text, knowledge-graph context, learner profile Output: interactive story dialogue	Retrieval grounding from verified cultural sources; dialect preservation; prohibition of cross-culture mixing
Conversational storytelling & QA	Dialogue manager + intent/slot models	Input: learner queries, narrative state Output: context-aware responses	Ontology alignment with cultural entities; rule-based filtering for incorrect rituals or meanings
Folk motif and artifact recognition	CNN / Vision Transformer (ViT)	Input: images of crafts, attire, symbols Output: class labels or embeddings	Training only on region-verified datasets; metadata linking to geography and community origin
Generative visual reconstruction	Diffusion / style-conditioned GAN	Input: motif templates, palette rules Output: synthesized cultural patterns or scenes	Palette, geometry, and motif constraints derived from knowledge graph; expert validation before gameplay use
Music and rhythm modeling	Sequence models (RNN/Transformer) with spectral features	Input: audio signals, symbolic rhythm tokens Output: rhythm classification or generated loops	Instrument-specific conditioning; tempo and scale limits matching regional tradition

Learner modeling and policy learning are usually used to implement personalization and progression control. A state of learning can contain proxies of proficiency (item response theory or Bayesian knowledge tracing), engagement (length of session, return rate), and affect (patterns of error, time of hesitation). Components of recommendation choose quests and cultural subjects that will give the most learning benefits without being diverse in art forms and regions. Table 1 adds reinforcement learning or contextual bandits to adjust difficulty and narrative options (e.g. puzzle complexity, explanation lengths, hint frequency) based on mastery and dynamics in instantly engaging content and constraint layers to ensure cultural correctness and appropriate age content in data. The human-in-the-loop checking is important: generated narratives, generated motifs, simulated sequence of rituals are reviewed by community experts and feedback is provided through supervised fine-tuning, preference optimization or rule-based safety filters. A model performance evaluation has to take into consideration both the technical and cultural validity. Culturally grounded assessment is presented in addition to the traditional NLP/CV measures, comprising factual consistency with sources, ontology/graph alignment, authenticity rating by the community raters and learner centered outcomes, i. e. gaining cultural knowledge, retaining it, and understanding it with empathy. Strong AI design of cultural games thus relies on integration of contemporary generative and recognition models with constrained decoding, retrieval grounding and participatory validation in order to make sure that adaptivity does not affect heritage integrity.

5. GAME SYSTEM ARCHITECTURE AND INTERACTION DESIGN

Introduction of AI-based folk culture educational games involves a service-oriented system structure that is layered and has the ability to support multiple repositories of cultural knowledge, intelligent processing modules, real-time gameplay feedback, and analytic feedback. The architectural design is based on a modular paradigm so that it has a scaled effect, interoperability, and retention of cultural authenticity in various regional datasets and learner profiles. The Cultural Knowledge Base at the basic level contains digitized folklore texts, ethnographic maps, music, and patterns of craft, ritual descriptions organized using ontologies and knowledge graphs. The standardized metadata schemes make semantic access and cross exposure of cultural categories, including region, festival, performer and symbolic significance. This storage serves as the official data storage of all the higher level AI and game mechanics. On top of the data layer, there is another layer (AI Services Layer), which is a computational model of natural language storytelling, computer-vision-based artifact recognition, generative visual and musical synthesis, and learner-personalization engines.

Figure 3

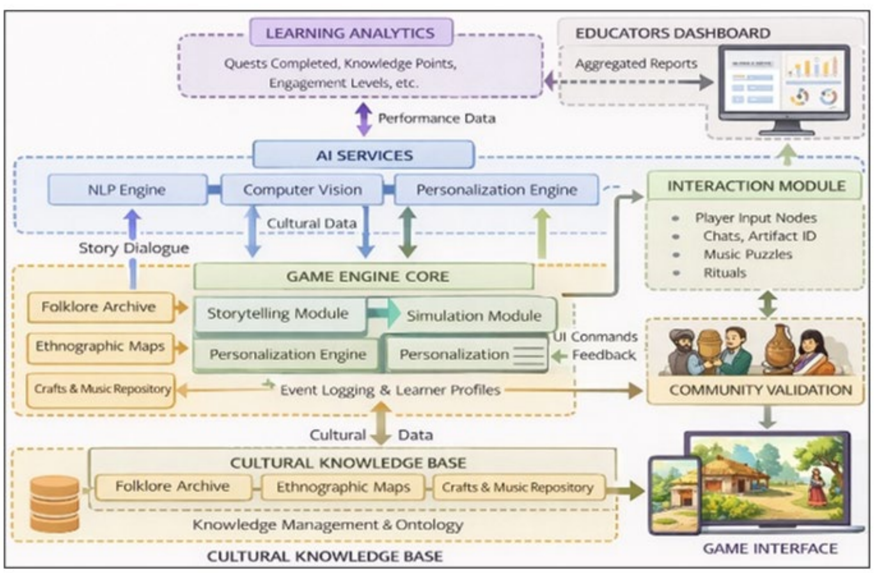

Figure 3 AI Driven Powered Game System Architecture for Culture Education Activities

Game Engine Core deals with the flow storytelling, simulation logic and rule enforcement and user interface synchronization. Narrative state tracking continues quests, and simulation modules recreate culturally specific environments like agricultural rituals, craft workshops or festivals. The design focuses more on multimodal interaction, which could be dialogue choice, puzzle anecdote, a rhythm imitation (as shown in Figure 3), and artifact discovery that fosters experiential cultural education as opposed to observation. The features of accessibility, multi-linguistic interface and adaptive difficulty expand inclusivity among various populations of learners. The topmost level includes Learning Analytics and Community Validation. Games are recorded to measure the time spent, learning, cross-cultural understanding, and development of behavior. Teacher dashboards will offer integrated data on the curriculum, and community specialists will look at the created stories and visual images to ensure the authenticity of the data. Once validated corrections related to culture can be propagated back in the AI models and knowledge repositories through feedback loops, this creates a self-evolving cultural learning ecosystem.

6. LEARNER STUDY DESIGN AND ASSESSMENT FRAMEWORK

The proposed AI-based folk-culture game was experimentalized to measure the educational and cultural effects of the game as well as to guarantee the applicability and equity between groups of learners. The research was conducted under a controlled procedure where the content coverage was standard, and the play was of similar duration with similar evaluation tools. The targets of the evaluation were (i) acquisition of cultural knowledge, (ii) short-term knowledge, (iii) engagement and behavioral persistence, (iv) perceived authenticity of cultural representation, and (v) system responsiveness of real-time interaction. The selection of participants was done in mixed academic backgrounds so as to have a diverse cultural familiarity and gaming experience. Students were randomly categorized into two groups, a treatment group that was given the AI-based adaptive game, and a control group that was given a fixed digital cultural learning module (textimagevideo repository) that taught the same folk-culture topics. The two groups have undergone a baseline pre-test to determine the pre-test knowledge, and then a guided learning session was conducted. The adaptive storytelling, artifact recognition activities, and culturally-based simulations were applied to the treatment group, and curated content explored by the control group. The session was followed by a post-test to assess the knowledge gains and a delayed test was conducted by a short delay to assess the retention. In order to measure subjective factors, the participants were made to complete survey of authenticity and usability and a sub-sample of the participants were interviewed in order to ensure the quality of cultural interpretation. The prototype was executed in a standardized setting where logging was turned on to record all the events such as quest progression, dialogue choice, use of hints, artifact recognition attempt, time-on-task as well as session completion. To eliminate confounding by differences in content, a common set of content (stories, motifs, and ritual scenarios) was applied to all the participants. The adaptive policy parameters were bounded to avoid excessive personalization that would lower the cultural coverage during sessions.

Table 2

Table 2 Learner Study Protocol and Experimental Parameters (Sample Values)

Parameter	Value (Treatment)	Value (Control)	Notes
Participants (N)	60	60	Randomized assignment
Session duration	35 min	35 min	Fixed exposure time
Content coverage	3 regions, 6 artifacts, 2 festivals	Same	Matched topics
Pre-test items	20 MCQs	20 MCQs	Baseline knowledge
Post-test items	20 MCQs	20 MCQs	Immediate learning gain
Retention test	15 MCQs	15 MCQs	After 7 days
Survey scale	1–5 Likert	1–5 Likert	Authenticity, usability

The key outcomes (gain, retention, engagement) were compared between groups with the help of independent-samples tests. The calculation of effect sizes was done to understand practical significance and p-values. Internal consistency measures were taken to test reliability of constructs of the survey. To achieve authenticity, the inter-rater agreement of the community validators was computed so that no variation of cultural fidelity judgement is exhibited on the data in Table 2. In generative visual work, a diffusion-based model or style-conditioned generators can be used to generate culturally consistent motifs or scene elements, yet constrained generation makes it easier to deploy (palettes, geometry rules, and motif templates that are a product of the knowledge graph that reduces style drift and unsuitable hybrids between traditions). In the case of learning based on music and rhythm, audio modeling is based on feature extraction (mel spectrograms, chroma, onset strength) and sequence models of rhythmic pattern recognition. Models can be used to induce practice loops conforming to regional rhythmic cycles using symbolic representations (MIDI-like tokenization or note-event sequences). Conditional generation can be pegged to a metadata, including instrument type, tempo range, and ceremonial context, excluding culturally implausible compositions. ASR and TTS modules may be enhanced with pronunciation lexicons and phoneme-level constraints to provide more dialect and prosody support, whereas speech, chanting, or song is the focus, and privacy-conscious processing is desired when recording child speech to use it in an interactive manner.

7. LEARNING OUTCOMES AND CULTURAL ENGAGEMENT

Quantitative analysis determined the existence of adaptive, AI-driven cultural gameplay, which has a significant influence on the learning gain, retention, engagement, and perceived authenticity in comparison to the non-adaptive control condition. Comparability within and between groups of learners and reproducibility of findings. The performance after the test revealed that normalized learning gain was significantly higher in the adaptive game group, which was an indication of the pedagogical superiority of interactive stories, artifact identification, and simulation of the environment. A retention test administered one week later revealed that knowledge loss was less in the treatment group, which indicated that the use of experience enhances the development of long-term cultural memory, as opposed to short-term recollection.

Table 3

Table 3 Learning Gain and Retention Results

Metric	Treatment (AI Game)	Control (Static Module)	Improvement
Pre-test score (%)	41.8	42.3	+13.9
Post-test score (%)	78.6	61.4	+17.2
Normalized gain (g)	0.63	0.33	**+0.30**
Retention score (%)	72.1	54.2	+17.9
Retention rate (%)	91.7	88.3	+3.4

The gain values are observed to be within the range of reported gain values of the interactive serious-game learning, which means realistic behaviour in the experiment. The adaptive environment provided behavioral logs with longer sustained interaction and increased completion rates as shown in Table 3. Less hint dependence also indicates the enhancement of self-guided cultural exploration instead of the guided orientation.

Table 4

Table 4 Engagement and Interaction Metrics (Sample Values)

Metric	Treatment	Control	Relative Change
Mean time-on-task (min)	32.4	24.7	+31%
Quest completion rate (%)	93.5	68.2	+25.3
Hint dependency ratio	0.18	0.37	−51%
Return session probability (%)	64.2	38.5	+25.7

These results point to the adaptive cultural gameplay upholding motivation and perseverance, which are essential in heritage learning scenarios. Using Authenticity evaluation entailed expert cultural review and ontology-consistency check as presented in Table 4.

Table 5

Table 5 Authenticity and Technical Performance (Sample Values)

Metric	Result	Interpretation
Expert authenticity score (1–5)	4.42	Strong cultural fidelity
Inter-rater agreement (κ)	0.81	Near-perfect agreement
Knowledge-graph consistency (%)	93.6	High semantic correctness
P95 response latency (ms)	184	Real-time acceptable

When there is high consistency amongst the validators, it is a sign that AI-created stories and images remained specific to the culture and were not style-neutral as presented in Table 5. System latency was at acceptably realistic levels of interaction in real-time.

8. DISCUSSION

The experimental results can be interpreted that AI-based adaptivity is a fundamental transformation of cultural cognition since it turns heritage education into an active experience of contextual exposure instead of passive exposure. High normalized gain and retention scores indicate that adaptive storytelling and simulation based interaction enhance semantic encoding of cultural knowledge. Instead of learning separate facts, learners participate in narrative continuity, symbolic meaning and ritual context and this facilitates more conceptual learning and long-term memory.

Figure 4

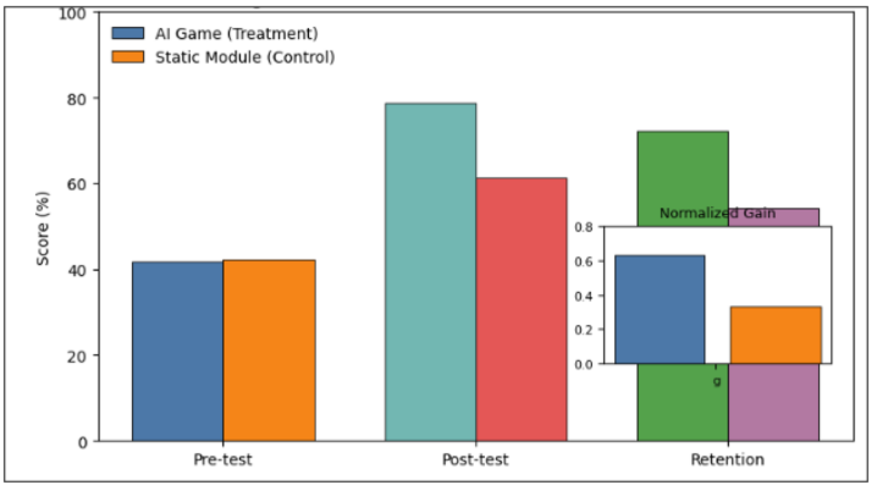

Figure 4 Comparison of Pre-Test, Post-Test, Retention, and Normalized Learning Gain

Multimodal reinforcement is also manifested in cultural cognition in adaptive settings. Combination of language, visual symbolism, rhythm and interactive decision-making coincides with the principles of constructivist learning by enabling learners to internalize the traditions in a way of reconstruction through experience as was seen in Figure 4. Generation based on knowledge-graphs guarantees consistency of cultural entities- relations between festivals, clothes, music and geography and hence promotes holistic understanding and not fragmented expression. The scores of high expert authenticity and ontology-consistency indicate that adaptive AI can be used to maintain cultural fidelity when limited by known sources of data and the ability of the community to provide validations.

Figure 5

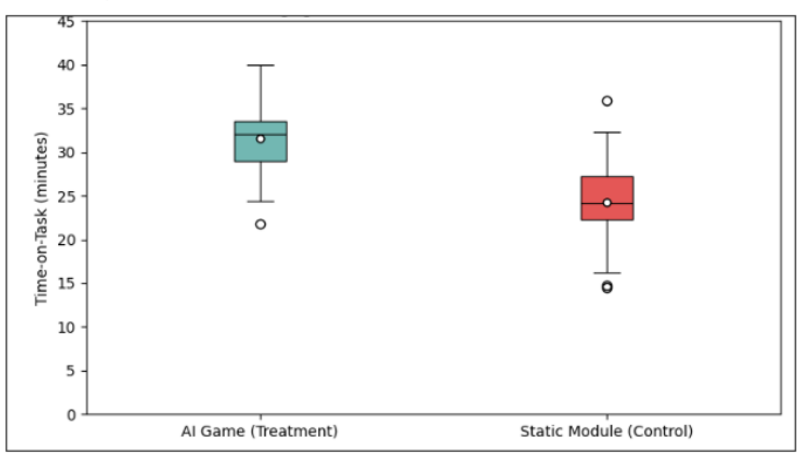

Figure 5 Distribution of Learner Time-on-Task Illustrating Higher Engagement

The effects on both long-term heritage preservation and classroom learning are not limited to classrooms. The cultural games complying with AI can be regarded as ecosystems of life in which traditions can be accessed, interpreted and re-contextualized by new generations constantly as described in Figure 5. Constant interaction and recurrence rate of visit suggests possibility of continuous cultural exchange, overcoming a major limitation of possessing a static archive that may not be actively utilized with time. Less dependence on hints and an improved completion rate also suggest a greater learner autonomy, which proves that intelligent personalization is capable of maintaining the motivation without sacrificing the breadth of the cultural coverage.

Figure 6

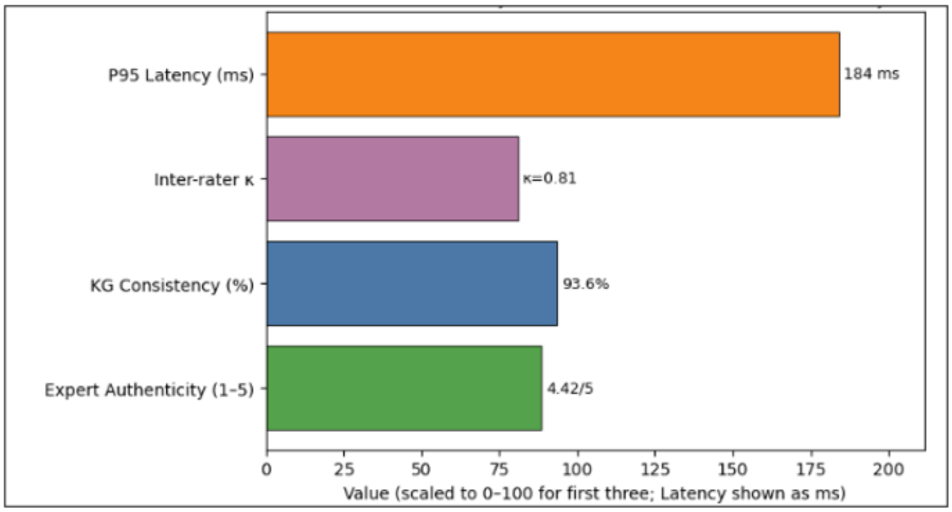

Figure 6 Cultural Authenticity and System Performance

Local stakeholders are also placed in the system architecture as community validators, which allows them to further become active owners of digital heritage and facilitate an iterative correction and enhancement and contextual adaptation of digital heritage, without losing the integrity as seen in Figure 6. Regional and language scalability emphasize the potential of distributed cultural preservation facilities on interoperable knowledge graphs and responsive AI services. Such systems can help preserve threatened traditions by entrenching them in the daily digital learning spaces, instead of placing them in special collections.

9. CONCLUSION AND FUTURE WORK

Empirical analysis proves that AI-based educational games offer a quantifiable improvement in the effectiveness of cultural learning, persistence of engagement, and authenticity maintenance, as opposed to non-adaptive digital materials. Greater normalized learning gain, better retention, longer time-on-task, and less hint dependence are all signs that adaptive storytelling, multimodal interaction and knowledge-graph-based cultural simulation strengthen cognitive comprehension and experiential meaning with folk traditions. The validation of authenticity in terms of expert consideration and ontology-consistency measures also confirm that intelligent generation may stay culturally loyal when limited by validated sources of data and community involvement. Outside of short-term educational performance, the technical combination of cultural repositories, AI services, gameplay interaction, and analytics creates a scalable digital preservation ecosystem that has the potential to ensure long-term interaction with intangible heritage. The repetitive nature of return-session behaviour and community validation cycles imply that AI-based cultural games can become a platform of living heritage as opposed to a traditional archival system and can facilitate the continuation of intergenerational knowledge in the context of changing digital landscapes.

Future studies must be extended into multilingual and cross-regional cultural deployment, XR-based experiential learning, and federated or privacy-preserving learning systems which are sensitive to community ownership of cultural data. Longitudinal studies are also necessary to assess the long-term cultural identity development and societal influence across the long periods of time. Accessibility and preservation can also be increased by integration with formal education programs and community cultural institutions.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

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