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Designing Serious Games for Cultural Heritage: A Framework Grounded in Critical and Experiential Theories

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Abstract

Against the backdrop of cultural heritage digitalisation, video games have emerged as an effective medium for cultural heritage preservation due to their strong interactivity, entertainment value, and cultural carrying capacity. However, current research faces challenges: a lack of critical perspectives, fragmented gaming experiences, and insufficient cultural communication efficacy. Through a comprehensive literature review, this study integrates Critical Heritage Studies, Virtual Restoration, MDA Framework, Flow Theory, and cross-cultural design, identifying their synergies and complementarities. It synthesizes three fundamental design principles: Triadic coupling-driven contextualisation, Pluralistic cultural epistemology, and Subject-Agentic aesthetic narration, explained through classic theories. The proposed gaming framework emphasizes participatory cultural communication while fostering authentic, immersive experiences, where aesthetic quality and perceptual control synergistically enhance interactive efficacy. Rooted in psychological, cognitive, and aesthetic theories, the framework explores the balance between entertainment experience and cultural sensitivity, optimizing player engagement, and promoting cross-cultural acceptance. It offers practical guidance for developers and a novel theoretical perspective for researchers.

Keywords Cultural heritage preservation; Player experience; Serious games; Game design.
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Introduction

Cultural heritage is categorised into tangible and intangible forms, with human activities, natural factors, and time diminishing their vitality. Heritage conservation similarly falls into two approaches: physical and virtual. The former relies on solid manufacturing technologies like casting, construction, and 3D printing for reconstruction (Dolfini & Collins, 2018), while the latter leverages digital technologies in the digital era to interpret, reshape, regenerate, or even perpetuate cultural heritage. Digital techniques such as 3D modeling, 3D visualization, virtual reality, motion capture, and 3D scanning are most commonly used in heritage research (Skublewska-Paszkowska et al., 2022). Interpreting heritage from new perspectives via emerging technologies and utilizing comprehensive digital displays play a pivotal role in promoting sustainable development (Tang & Wang, 2024).

The advancement of digital technologies and growing digitization awareness are driving comprehensive digital transformation in cultural heritage conservation. Within both ICH (Intangible Cultural Heritage) and TCH (Tangible Cultural Heritage) domains, 3D-based digital games have emerged as superior preservation media due to their immersive capabilities, rich interactive opportunities (Theodoropoulos & Antoniou, 2022), effective educational potential, and profound cultural dissemination capacity (Rattanarungrot et al., 2024).

Digital games can effectively disseminate cultural heritage content through purposeful game design. As the primary consumers of the digital gaming industry and the main bearers of traditional cultural revival, the younger generation benefits from the accurate integration of heritage content into games. This organic combination of games and cultural heritage dissemination guides the younger generation in understanding, interpreting, and identifying with traditional culture (Qin, 2017). It also enhances user engagement and immersion, allowing them to absorb cultural content either subtly or actively while prolonging the retention of knowledge (Torsi et al., 2020). According to the *Research Report on Games to Help Education* published by the Institute of Philosophy of Games, game-based educational practices are categorised into Gamification in Education and Game-Based Learning. The latter emphasizes using in-game scenarios and mechanics to facilitate player learning and foster a sense of achievement. Against this backdrop, SGs—which use cultural heritage as narrative content, prioritize educational goals in mechanism and aesthetic design, and stimulate players' intrinsic learning motivation—have garnered increasing attention. These games aim to enhance players' cognitive understanding and cultivate critical reflection (Liu et al., 2024; Zhang & Shang, 2018). Current practices, however, predominantly focus on technical implementation while lacking critical reflection on the historical significance and social values of cultural heritage. Furthermore, existing educational games face challenges, including fragmented experiences and insufficient cultural transmission efficacy.

This paper analyses the systematic structure of the MDA framework (Mechanics, Dynamics, Aesthetics) for understanding and guiding game design, experiential dimensions of flow theory, and adaptive features of cross-cultural design in human-computer interaction. Building upon virtual restoration concepts in digital technology applications, we integrate value-oriented perspectives from critical restoration theory to formulate a core game design element system comprising: Triadic Coupling-Driven Contextualization, Pluralistic Cultural Epistemology, and Subject-Agentic Aesthetic Narration. The study aims to construct a culturally inclusive game design framework through organic integration of foundational gaming theories and critical perspectives, elucidating its mechanisms for balancing entertainment experiences with cultural sensitivity while optimizing player engagement and cross-cultural receptivity.

Methodology

This study adopts a qualitative research paradigm, whose core lies in conceptual analysis and theoretical synthesis, aiming to develop a guiding design framework. The ultimate objective is to construct a culturally inclusive game design framework and profoundly elaborate on the specific action mechanisms through which the framework balances entertainment experience with cultural sensitivity and optimizes player engagement alongside cross-cultural acceptance. This research type emphasizes the interpretation and understanding of complex phenomena rather than mere quantitative measurement.

Main Research Methods

1. Literature Review: This study identified, screened, and synthesized core theories and concepts related to cultural heritage conservation, gaming experiences, and cross-cultural design through reliable databases.
2. Multi-theory Integration: Core theories identified via literature review were deeply analysed, compared, and critically reflected upon. The aim is to organically integrate key elements across theories, forming new and more comprehensive design principles. This integration is not a simple superimposition but intends to uncover synergies and complementarities among different theories.
3. Conceptual Synthesis and Framework Derivation: Based on the outcomes of multi-theory integration, this study logically derives and elaborates on three proposed design principles: Triadic coupling-driven contextualization, Pluralistic cultural epistemology, and Subject-Agentic aesthetic narration. This process reveals the constituent elements of the framework and their internal logical relationships.

Literature Identification, Screening and Selection Process

- Keyword Strategy: Literature retrieval primarily employed the following keyword combinations to ensure breadth and depth of search: "serious games", "cultural heritage conservation", "gaming

experience", "flow", "MDA framework", "cross-cultural design", "critical heritage studies", "virtual restoration", etc. These keywords cover the core domains and key theories of this study.

- Databases and Sources: Literature types focused on peer-reviewed journal articles, high-level conference papers, and academic monographs in related fields. Academic databases such as Web of Science, Scopus, and Google Scholar were selected.
- Screening Criteria: Inclusion criteria for literature mainly included: 1) high relevance to themes such as cultural heritage digitisation, serious game design, gaming experience, and cross-cultural communication; 2) publication within the past 5 years (excluding foundational classic theoretical works); 3) language in Chinese or English; 4) research types being theoretical, conceptual, or empirical studies with clear methodologies. Exclusion criteria included non-academic publications, duplicate documents, and literature with low relevance to the research theme.
- Literature Management: All collected literature was organized and categorised using professional bibliographic management software to facilitate subsequent citation, annotation, and analysis, ensuring transparency and efficiency in the research process.

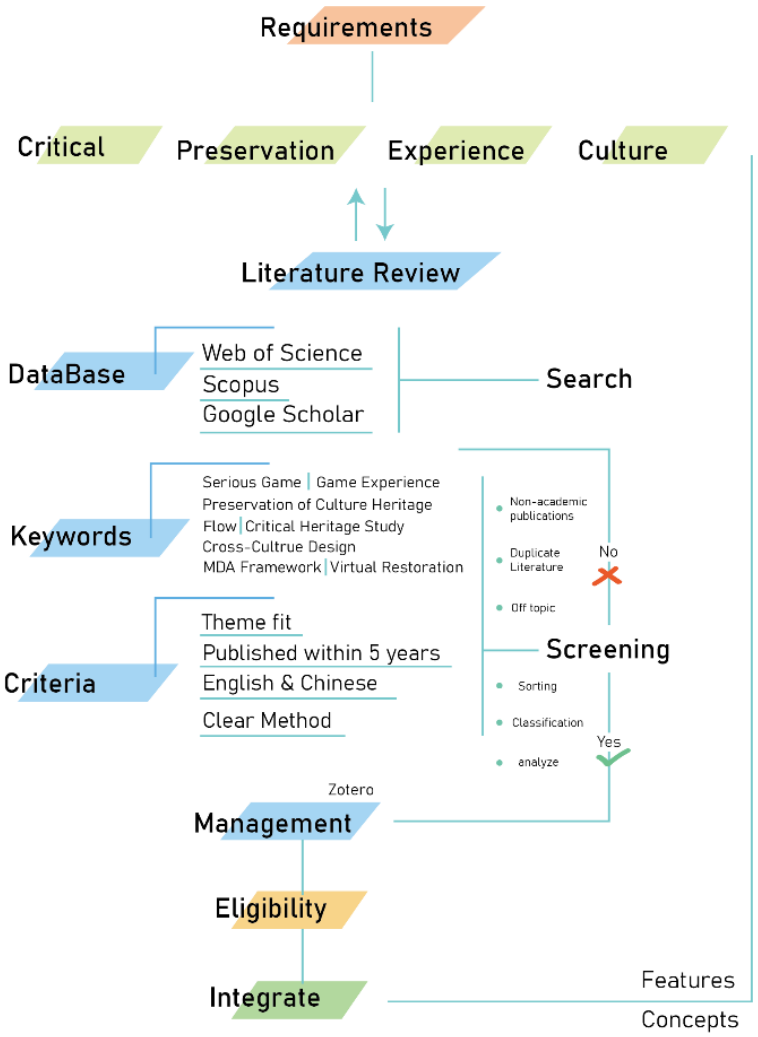

Figure 1. Research Process

Theoretical Foundations of the Framework

Critical Restoration Theory (CRT)

This study proposes Critical Restoration Theory (CRT) to address the lack of critical reflection in the digital restoration of cultural heritage. CRT synthesizes Critical Heritage Studies (CHS) and Virtual Restoration Theory (VRT), advocating systematic documentation and critical examination of heritage content prior to digital transformation, with particular attention to controversies, values, and cultural significance.

Emerging in the late 20th century as a response to Western-centric and state-dominated heritage management paradigms, CHS deconstructs the purported "neutrality" of heritage while emphasizing its dynamic and contested nature (Alexandra & Aleksandr, 2020). Its applications span heritage activism, digital heritage, urban heritage, and intercultural dialogue. Two key domains intersect with our framework:

1. Digital Heritage: Provides critical perspectives for analysing geopolitical and cultural impacts of digital heritage platforms (e.g., Google Arts & Culture) (Grincheva & Stainforth, 2024).
2. Intercultural Dialogue: Promotes cultural plurality by bridging diverse communities through heritage conservation practices (Lixinski, 2023; Terracciano, 2020).

CHS encompasses four core concepts:

1. Authorised Heritage Discourse (AHD): Exposes power imbalances in heritage narratives, advocating for marginalised perspectives (Alexandra & Aleksandr, 2020).
2. Heritage as Process: Recognizes heritage's dynamic adaptation to societal evolution (Kalinycheva, 2024).
3. Intangible Heritage: Emphasizes safeguarding practices, languages, and customs alongside tangible artifacts (Zhao & Hu, 2024).
4. Memory and Identity: Explores heritage's role in shaping individual/collective consciousness during sociocultural upheavals (Stevens, 2023).

CHS challenges hegemonic approaches in heritage conservation, fostering inclusive frameworks that support cultural equity, conflict resolution, and diversity. Its central tenet asserts: Heritage concerns not the preservation of the past, but the creation of futures.

Virtual Restoration Theory (VRT) emerged in tandem with the growing awareness of modern cultural heritage preservation and the progressive advancement of digital technologies. It advocates minimizing reliance on physical restoration methods for physically damaged heritage sites, instead

employing advanced technologies to balance authenticity and virtuality, thereby enhancing immersion. The practical workflow of virtual restoration typically involves data collection, 3D modeling, digital restoration, and visualisation interaction. This process also entails the selection, reconstruction, encoding, and decoding of cultural heritage content.

For instance, in the case of the restoration of the Great Wall's Nine Eyes Watchtower, specific restoration targets were identified through content filtering of military cultural heritage. Physical evidence of geometric information was collected using drones and cameras for digital scanning. Subsequent steps included interpreting, reconstructing, and encoding information from existing records, ancient texts, and images. Finally, virtual interpretation was achieved through decoding by integrating 3D modeling with scanned scenes (Li, Z et al., 2024).

In another case involving the restoration of Bagong House, researchers integrated virtual restoration theory with evidence-based medicine design methodologies. The critical appraisal step addressed the overemphasis on technology in virtual restoration, thereby enhancing rigor. Ultimately, under the guidance of virtual restoration theory, 3D modeling was used to establish restoration references, which informed physical restoration efforts (Zhang, Z et al., 2023).

Both projects based on virtual restoration theory adhered to a rigorous technology-dependent approach, ensuring the effectiveness and reliability of the work through scientific data analysis and reasoning. However, future conservation designs should incorporate critical, ethical, and culturally sensitive considerations, approaching the relationship between technology and culture with caution.

Flow Theory

Flow Theory, first proposed by Mihaly Csikszentmihalyi, describes a psychological state of immersion and intense accomplishment that occurs when an individual engages in an activity where challenges and skills are balanced. Key factors include clear goals, immediate feedback, and the alignment of consciousness with action (Yan, 2023). The theory has broad applications, such as in sports training, classroom teaching, workplace activities, tourism, leisure, and gaming.

In digital games, the critical factors for achieving a Flow state are game design and player experience. First, a player's ability to successfully complete in-game tasks is paramount. Only when challenges and skills are balanced can players avoid negative psychological states and enter a state of immersion. Notably, immersion is transient and serves as a prerequisite for achieving Flow (Cruz & Uresti, 2017). Additionally, the process of task performance and play promotes entry into Flow, leading to successful learning outcomes (Pavlas, 2010).

Second, clear task objectives and immediate feedback are essential. The former reduces confusion and anxiety stemming from uncertainty, while the latter enhances a sense of accomplishment and emotional elevation (Oliveira et al., 2023).

Third, the distortion of self-awareness and time perception, along with automaticity, are critical. During Flow, players typically engage solely in task-related activities. Reduced amygdala activity may lead to diminished self-awareness and improved performance, while prolonged practice or gameplay can decrease prefrontal cortex activity, resulting in smoother and more fluid actions (Khoshnoud et al., 2020).

The application of Flow Theory in gaming can be summarized in three phases: pre-design, in-game, and post-evaluation. This framework guides game design (Wang et al., 2024; Pavlas, 2010), dynamically adjusts difficulty to maintain Flow (Arzate, 2017; McDaniel et al., 2024) and uses Flow metrics to assess design effectiveness and educational outcomes (Oliveira et al., 2023; Cai et al., 2022).

Flow Theory is highly compatible with digital games, aiding developers in evaluating a game's appeal and playability. Its interdisciplinary and personalized adaptive applications transform emotional benefits from Flow into tangible knowledge, expanding its research potential and providing a robust theoretical tool for gamified education and cultural dissemination.

MDA Framework

The MDA Framework (Mechanics, Dynamics, Aesthetics), proposed by Hunicke et al. (2004), is an interdisciplinary research method derived from three foundational components: Rules, System, and "Fun." It is designed to understand games and guide their design and iteration. Mechanics refers to the foundational tools and components with low perceptibility, representing the underlying logic or rules that ensure smooth gameplay. Dynamics, the core layer of the MDA Framework, is abstract yet connects the upper and lower layers. It encompasses all interactions within a game, runs throughout the entire process, and is strictly controlled by developers. Aesthetics initially described the ultimate holistic experience of players; however, this characterization fails to fully explain the conditions and outcomes of emotional responses, thus overlooking player subjectivity (Dormans, 2012; Hunicke et al., 2004).

While the three layers reveal distinct focuses between players and developers and have gained significant academic attention as a universal game design method, their interrelationships remain inadequately explained. Each layer's content is overly narrow, lacking sufficient breadth and depth, particularly regarding overall narrative and experience (Othlinghaus-wulhorst & Hoppe, 2020). The MDA Framework should serve as a foundational tool for novice developers, offering a gradual approach

to game design rather than overemphasizing the interpretation of each layer (Dormans, 2012). This critique paves the way for integrating the MDA Framework with other theoretical frameworks.

Many studies on the MDA Framework have improved it by incorporating other theories or methods, often in a critical context, to better suit specific game types. This indicates that the framework's greatest contribution lies in providing a basic structured approach that clarifies three key elements, serving as a cornerstone for mechanism design and game development. Future trends suggest that expanding and supplementing the MDA Framework with additional methods and theories will lead to more effective and targeted frameworks.

Cross-Culture Design (CCD)

The initial implementation of cultural heritage preservation relies on restoration that considers contemporary context. However, it is essential to further explore the abstract spirit, civilization, and modern interpretations and dissemination of cultural heritage created by cultural groups. Cross-cultural design (CCD), derived from multiple research frameworks, offers methodological and principled guidance for developing digital works with cultural inclusivity and sensitivity.

Cognitive differences in culture primarily stem from human psychology, as different cultural groups universally differ in information acceptance and processing. Player-centered CCD must first address how to meet user experience and expectations within Graphical User Interface (GUI) systems (Plocher et al., 2021). Additionally, the impact of culture on identity and group cohesion is significant, shaping cognitive subconsciousness, unique cognitive styles, and behavior. Cross-cultural communication and learning must consider cultural understanding, conflict, and translation (Lee, 2016; Plocher et al., 2021).

Culture is diverse and complex, and cross-cultural communication requires understanding its dynamic nature, often involving multiple networks formed through cultural interaction. Design must go beyond surface visual information such as colours, icons, patterns, character appearances, and equipment designs. Instead, it should incorporate deeper implicit information, including values, ethical concepts, and collective memory within shared cultures (Comi et al., 2024; Sun, 2012). Hofstede (1991) identified key factors of cultural differences across five dimensions, elucidating core group cultural differences across visible symbolic, implicit contextual and deep spiritual cultural layers. Combined with the MDA framework, player attention evolves from superficial Aesthetics to deeper Mechanics.

This paper integrates cross-cultural design in Human-Computer Interaction (HCI) into a three-layer cultural cognition model within the framework:

1. Surface Symbolic Layer: Directly experienced visual symbols or auditory information.

2. Middle Behavioral Layer: Behavioral interaction rules, task logic, and alignment with cultural group behavioral norms and cognitive styles.
3. Deep Value Layer: Historical significance, spirit, memory, ethics, and values behind a culture.

Video games provide an efficient platform for cross-cultural communication, ensuring players experience cultural inclusivity and unique appeal. The cross-cultural design perspective also offers developers opportunities to resonate with diverse player groups, leading the future of gaming towards a balance of entertainment and education.

Comparative Analysis of Theories

A comparative analysis of the four theories and methods reveals three main components and characteristics of the framework. Firstly, both Critical Heritage Studies (CHS) and Virtual Restoration (VR) aim to promote the dissemination and preservation of cultural heritage, with both emphasizing the necessity of leveraging new technological advancements for digitization. The critical perspective of CHS compensates for VR's overreliance on technical restoration methods, which often neglect user participation and cultural dissemination. The dynamic interaction of Critical Restoration and the eight-channel experiential model of Flow Theory together highlight enhancing player experience through human-computer interaction, improving emotional states to induce immersion and achieve Flow. Additionally, authenticity in games represents sensory stimulation and cultural familiarity for players. Emotional improvement in aesthetics, integrated into the MDA Framework through system interaction, is dynamic. The static appreciation of cultural symbols is complemented by the Surface Symbol Layer of Cross-cultural Design (CCD), forming a key characteristic known as subject-agentic aesthetic narration.

Secondly, Critical Restoration determines the establishment of digital cultural heritage archives and the selection of specific content. Under the aesthetic supervision of the MDA Framework, some content is transformed into visual cultural symbols, encouraging participatory preservation. The middle behavioral layer and deep value layer of CCD assist developers in creating interactive levels and narrative methods that help players understand the spiritual and cultural essence behind heritage, constructing the important concept of pluralistic cultural epistemology.

Lastly, the concept of triadic coupling-driven contextualization is formed by three-dimensional technical development, game mechanism design, interaction rule design, dynamic difficulty adjustment, and Flow feature evaluation from the four theories and frameworks. This integration underscores the collaborative role of these elements in creating effective and engaging cultural heritage experiences.

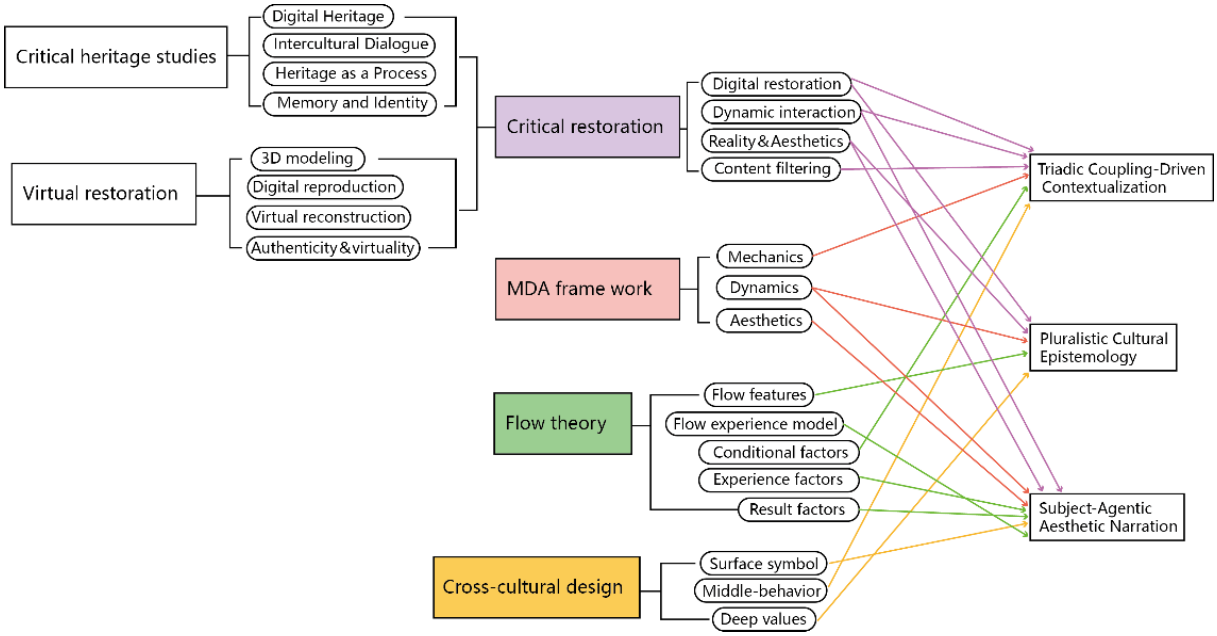

Figure 2. Theoretical Induction Process (Photo Credit: Author's Own Drawing)

Table 1. Core theories and their contributions to this study

Theory	Main Proposer/Background	Core Concepts/Ideas	Relevance To This Study (Specific Contribution)
CRT	This study combines CHS with virtual restoration	Critical reflection, heritage dynamics, multi-participation, balance between technology and culture, immersion	This framework furnishes a value-oriented and critical perspective for the digital preservation of cultural heritage, emphasizing the scrutiny of cultural meanings in technological applications and promoting diverse participation.
FLOW	Mihaly Csikszentmihalyi	Balance between challenges and abilities, clear goals, timely feedback, immersion and selflessness	It provides a psychological foundation for optimizing player experience, enhancing game attractiveness and playability, guiding game mechanics design to foster deep engagement and learning.
MDA	Hunicke et al. (2004)	Three-layer structure: mechanism, dynamics, and aesthetics	The framework offers a fundamental structured approach to understanding and guiding game design, serving as a key basis for mechanical design and game development .
CCD	(Plocher et al., 2021) (Comi et al., 2024)	Cultural cognitive differences, identity recognition, multiple values, three-layer model	It directs the creation of culturally inclusive and sensitive digital works, ensuring that game design can resonate with a broad player base and facilitate cross-cultural communication.

Serious game design in cultural heritage preservation attracts and enhances player experience through unique cultural content and gameplay mechanisms. Players enter a flow state through narrative interaction and aesthetic appreciation, learning and understanding novel cultural knowledge to complete a positive feedback loop.

Triadic Coupling-Driven Contextualization

This concept underscores the importance of technology. Game scenarios developed through digital technology serve as the foundation for immersive player experiences, resonating with autonomous cultural cognitive learning. It meets psychological needs through a sense of achievement and belonging, aligning with the assertions of Flow Theory, Cross-Cultural Design (CCD), and Critical Restoration Theory (CRT).

Pluralistic Cultural Epistemology

This emphasizes that cross-cultural interaction is key to cultural dissemination and progress. Diverse participant involvement drives content creation and collaborative construction.

Subject-Agentic Aesthetic Narration

This creates visually engaging narratives that satisfy players' aesthetic experiences. By transforming cultural content into storylines, it fosters player immersion and association within interactive game environments.

Framework Content and Characteristics

Triadic Coupling-Driven Contextualization

Flow Experience Conditional Factors

Flow Theory outlines three elements: conditional factors, experiential factors, and outcome factors. The conditional factors, which are prerequisites, are essential for designing the game mechanics layer:

1. Clear and Specific Goals: Goals are necessary prerequisites for value realization. When players receive clear task instructions, they proactively plan to complete these tasks, thereby gaining positive emotions. Conversely, in the absence of clear goals, while player freedom and exploration are enhanced, emotional declines occur rapidly, disrupting the Flow state.
2. Accurate and Timely Feedback: Feedback can be categorized into positive rewards, neutral gains, and negative punishments. Regardless of the type, feedback is essential after each player interaction to maintain or stimulate the player’s engagement.
3. Balance of Skills and Challenges: This factor is central to achieving and sustaining a Flow state. It is both a prerequisite and a sustaining element for deeper Flow engagement. Given the diverse knowledge and skill backgrounds of players, imbalance can lead to frustration from overly challenging tasks or boredom from under-challenging ones. Optimal gaming conditions are created only when these elements are balanced (Oliveira et al., 2023; Pavlas, 2010; Su et al., 2016).

The interactive interface in games is essential for assisting players in viewing information, interacting with environments, and analysing data through the integration of functional visual elements. However, excessive GUI information may compromise visual clarity and immersive authenticity. Customizable interface designs with strong utilitarian orientation prove more effective in guiding players, particularly when complemented by clearly defined objective acquisition paradigms and systematic task management frameworks spanning initiation, execution, and completion phases. While high-value rewards appropriately incentives players to overcome significant challenges, low-value incentives remain crucial for maintaining engagement through immediate feedback mechanisms. This underscores the importance of balancing fragmented in-game rewards with failure penalties to regulate psychological thresholds. Given the dynamic nature of gaming systems, current research on challenge-capability equilibrium primarily focuses on dynamic difficulty adjustment (DDA), particularly through real-time modification of NPC attributes and capabilities. Many games additionally offer pre-game difficulty customization options (Su et al., 2016), as exemplified by Sifu's adjustable combat parameters (character/enemy attributes, attack patterns, weapon configurations) and Surviving the Aftermath's modifiable macro-environmental conditions. Future investigations should pursue dimensional expansion and in-depth exploration of challenge mechanisms to sustain prolonged flow states.

Game Scenario Construction

Virtual restoration theory posits that digital technologies serve as effective instruments for cultural heritage preservation, advocating the creation of authentic virtual environments to deliver immersive experiences. Users demonstrate enhanced concentration and cognitive capabilities within these interactive, reality-based contexts, thereby achieving deeper comprehension of scenario content (Süvari et al., 2023). In a Spanish archaeological site restoration case, developers employed the real-time rendering game engine Unreal Engine to construct a heritage scenario incorporating high-fidelity model assets, simulated environmental lighting, physically accurate material properties, and mission-critical interaction design, which substantially improved user immersion and interactive satisfaction (González et al., 2022). Another hydrological heritage restoration project utilised digital elevation models to visually contrast natural versus artificial drainage networks, revealing anthropogenic modifications' ecological impacts and providing actionable insights for ecosystem management. This case empirically validates scenario-based cognitive enhancement, demonstrating that digital contextualization facilitates profound understanding of complex systems while enabling systematic problem diagnosis and future optimization pathways (Paul et al., 2022). As inherently scenario-interactive media, digital games constitute a robust platform for cultural dissemination through cultural identity reinforcement and cross-cultural learning. While game scenario construction represents technology-driven artistic expression, this study prioritizes technical dimensions—including engine technologies, artistic design techniques, audio engineering, and game design frameworks (level design, mechanics, and experience

optimization). Artistic expression and cultural transmission aspects will be elaborated in subsequent sections.

Pluralistic Cultural Epistemology

Multifaceted Participation

The Cultural Heritage Synergy (CHS) framework asserts that engaging diverse community groups in heritage stewardship and practice is paramount for achieving sustainable, inclusive, and culturally sensitive research objectives, particularly given persistent issues of power asymmetries and universal applicability gaps in heritage governance (Alexandra & Aleksandr, 2020). The heterogeneous nature of cultural heritage necessitates classification systems accommodating its inherent adaptability, flexibility, and complexity. While participatory processes are inherently complex and unpredictable, they remain indispensable for deciphering heritage pluralism, surfacing divergent perspectives across epistemic communities, and advancing dynamic heritage research methodologies (van Knippenberg et al., 2021). Participatory heritage practice embodies a human-centered sustainable impetus, framing participation as both a right and a mechanism for revitalizing heritage governance through shared decision-making—a critical challenge demanding sustained scholarly attention (Rosetti et al., 2022). For instance, Laluk's (2022) study underscores the imperative of collaborative archaeology with Indigenous communities facing systemic marginalization, ultimately achieving cultural self-determination in heritage resource management to address historical power imbalances and participation disparities. In serious games, multifaceted participation extends beyond broadening cultural dissemination; it necessitates embedding critical reflective frameworks within game design and narrative architectures.

Cultural Dimensions

Hofstede's (1991) five-dimensional cultural taxonomy remains foundational for cross-cultural communication research:

1. Collectivism vs. Individualism: Individualistic cultures (e.g., United States, United Kingdom, Australia, Canada) prioritize personal agency and heroic narratives, emphasizing self-reliance in overcoming challenges. Conversely, collectivist societies (e.g., Latin American and select Asian nations) value communal solidarity and reciprocal support systems.
2. Power Distance: Measures societal acceptance of hierarchical authority. High-power-distance cultures endorse autocratic leadership and deference, whereas low-power-distance groups emphasize egalitarianism.
3. Masculinity vs. Femininity: Masculine cultures enforce rigid gender roles and competitive ethos, while feminine counterparts prioritize inclusivity, flexibility, and relational harmony.

4. Uncertainty Avoidance: Reflects tolerance for ambiguity. Strong-avoidance cultures (e.g., certain religious societies) enforce strict normative rituals, contrasting with exploratory-oriented groups embracing novelty and experiential flexibility.
5. Short-term vs. Long-term Orientation: Short-term-oriented cultures prioritise present gratification and tradition adherence, whereas long-term-focused groups (e.g., pragmatic East Asian societies) emphasize strategic foresight, resilience, and systematic problem-solving, prioritizing sustainable outcomes over immediate gains (Plocher et al., 2021; Hofstede et al., 2012).

Collaborative gameplay mechanics manifest pervasively across digital entertainment platforms, extending beyond conventional multiplayer team objectives—exemplified by *League of Legends*' role-specific coordination across five positions and *Back4Blood*'s zombie eradication requiring non-solo cooperation—to encompass single-player mechanics like combo systems, NPC alliances, and companion recruitment. However, player agency fundamentally dictates team-based versus individualistic approaches, as evidenced in *Rockstar Games*' titles: *GTA Online* and *Red Dead Redemption Online* accommodate both organized posse gameplay and "lone wolf" autonomous strategies. These behavioral patterns stem from divergent cultural cognitive frameworks, particularly evident in strategic decision-making paradigms—whether prioritizing immediate tactical advantages at the expense of long-term optimization or adopting delayed gratification approaches. Serious game design must therefore integrate cross-cultural cognitive variations through deliberate visual, interactive, and mechanical adaptations while preserving core cultural authenticity. Successful transcultural dissemination catalyzes intercultural convergence, manifesting at individual player levels as cultural literacy acquisition, mnemonic cultural imprinting, and identity-driven prosocial engagement.

Subject-Agentic Aesthetic Narration

Agency Interaction

Flow theory identifies two critical experiential dimensions: the *fusion of action and awareness*, characterized by complete attentional focus, and the *latent sense of agency*. The fusion of action and awareness denotes a state where players' physical actions become fully synchronized with their goal-oriented consciousness, generating immersive satisfaction through cognitive unification—a capacity influenced by players' intrinsic self-regulatory traits and GUI-mediated guidance (Pavlas, 2010; Harris et al., 2019). The latent sense of agency reflects players' perceived ability to influence narrative trajectories and outcomes through intentional decision-making. This empowerment fosters achievement motivation, sustaining engagement through self-directed progression (Trivedi & Teichert, 2017). In-game agencies typically stem from non-linear environmental exploration with multi-layered interaction opportunities, branching narratives shaped by consequential choices (e.g., dynamic character

relationships and cascading plot outcomes), and open-ended problem-solving that encourages combinatorial resource utilization rather than enforcing prescriptive solutions.

Aesthetic Narration

The CHS framework emphasizes that heritage construction and perception require *mnemonic-recognitive studies*, which examine how individual and collective memories shape cultural identification. This recognition-memory duality operates through two mechanisms: *recollection* (context-triggered retrieval of episodic details) and *familiarity* (abstract resonance with prior experiential schemas) (Mandler, 2008). Memory serves as the foundation for cultural identity formation and authenticity perception, functioning as dynamic constructs continuously reshaped through narrative practices (Andersson & Frihammar, 2022). Heritage-oriented serious games leverage this duality by activating intra-cultural memory reinforcement within native communities and inducing cross-cultural familiarity through narrative mirroring, ultimately fostering acculturation via gamified pedagogy.

Within the MDA framework, *aesthetics* refers to emotion-evoking experiential qualities comprising six dimensions: lighting aesthetics (atmospheric enhancement through dynamic illumination), cultural artifact aesthetics (integration of high-fidelity heritage objects), semiotic aesthetics (symbolic-meaning conveyance), player-preference alignment (customizable content generation), narrative input (story-driven emotional arcs), and graphical aesthetics (visuospatial impact amplification). These elements collectively drive emotional contagion and mental imagery formation, constituting core motivators for affective engagement (Dormans, 2012; Wang et al., 2021; Lee & Enschot, 2022).

Integrating critical restoration (providing cultural heritage content and technical foundations), the MDA framework (structuring game architecture), flow theory (optimizing experiential validation), and CCD (expanding cultural dissemination), this study proposes the R-FMC-C framework. Its core features include triadic coupling-driven contextualization (systemic integration of spatial, temporal, and cultural vectors), pluralistic cultural epistemology (multi-perspective knowledge co-construction), and subject-agentic aesthetic narration (player-centered narrative agency).

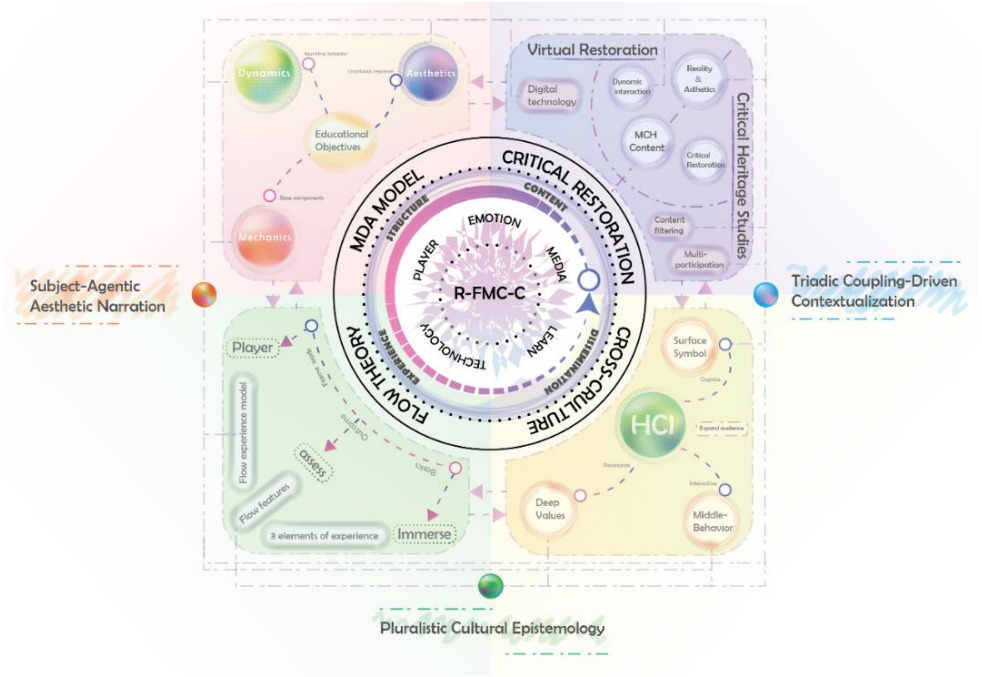

Figure 3. Theoretical Framework (Photo Credit: Author's Own Drawing)

Table 2. Design framework principles and theoretical support matrix

Design Framework Principles	Core Concept	Main Theoretical Support (And Key Elements)	Contribution Points
Triadic Coupling-Driven Contextualization	Emphasize the importance of technology, build immersive gaming scenarios, and meet the psychological needs of players.	Virtual Restoration theory (real situation, immersion), flow theory (experience conditions, skill challenge balance), MDA framework (mechanism design), CCD (cultural cognition learning autonomy)	Ensure the technical foundation of the gaming environment and the player immersion experience.
Pluralistic Cultural Epistemology	Emphasize cross-cultural communication, encourage diverse participation, and promote cultural understanding and construction.	Critical heritage studies (multi-participation), MDA framework (cultural symbol transformation), CCD (three-layer model of cultural cognition, Hofstede cultural dimension)	Enhance cultural inclusiveness, expand the scope of cultural dissemination, and promote cultural exchanges.
Subject-Agentic Aesthetic Narration	Create an aesthetic narrative environment that is highly ornamental, immersive and inspires players' sense of control and cultural identity.	Flow theory (subject interaction, sense of control), MDA framework (aesthetic concept), critical heritage studies (memory and identity), CCD (surface symbolic layer)	Optimize players' emotional experience and promote cultural identity through narrative and aesthetics.

Design Framework Theoretical Exposition

Having delineated the framework's components and characteristics, this chapter elucidates the theoretical underpinnings of how serious games facilitate cultural heritage preservation through enhanced player experience.

Player Experience Enhancement

Environmental Storytelling

Building upon Don Carson's pioneering emphasis on environmental authenticity in gaming (derived from theme park design experience circa 2000), Henry Jenkins subsequently formulated Environmental Storytelling through synthesizing spatial narrative theories from literature and architectural scenography. Jenkins posits game developers as world-builders rather than mere storytellers, arguing that spatialised storytelling—activated through players' intrinsic skills and expectations—optimizes narrative immersion. This approach leverages four interdependent mechanisms:

Evocative Spaces utilize narrative stimuli (plot elements, level design, and symbolic cues) to trigger players' pre-existing cultural memories, particularly effective in adaptations of film/anime franchises. However, over-reliance on familiar content without novel interpretive perspectives risks player disengagement through cognitive redundancy.

Enacting Stories negotiates player agency against narrative constraints. Players initially gain behavioral opportunities through environmental affordances (animations, level architecture, mechanical systems), subsequently achieving immersion through role embodiment. This process demonstrates dual narrative intervention modes (holistic vs. localized) and underscores the necessity of balancing experiential accessibility with technical sophistication.

Embedded Narratives employ non-linear storytelling through environmental semiotics, conceptualising game spaces as mnemonic palaces. Through strategic placement of fragmented narrative elements, designers provoke exploratory behavior, ultimately enabling players to reconstruct coherent understanding through epiphanic synthesis—a process yielding heightened achievement motivation and unique perspectival comprehension.

Emergent Narratives represent ultimate player agency actualization, where narrative trajectories remain dynamically responsive to behavioral inputs rather than predetermined. This paradigm creates procedural story-generation environments through systemic interaction architectures (Jenkins, 2004).

These narrative modalities collectively demonstrate how ludic spatial configurations influence experiential quality. The framework aligns with this theoretical foundation by advocating culturally symbolic, authenticity-driven interactive spaces that guide players into flow states.

Evocative Spaces illuminate players' retrieval of prior experiential and affective memories, aligning with intracultural resonance phenomena. In-game visual-cultural semiotics and interactive cultural cues activate mnemonic recall, where shared cultural schemas effectively modulate players' emotional states. Crafting immersive game spaces necessitates macro-level excellence in mechanism-

driven level design and aesthetically enriched sensory interfaces, complemented by micro-level refinements such as cutscene choreography, transitional animations, and NPC/prop interactivity. Achieving equilibrium between these layers demands advanced 3D technical infrastructure and multidisciplinary design expertise—precisely the developmental priorities emphasized by this framework. Player agency thrives when minimizing mandatory cutscene interruptions and subverting linear narratives, embodying flow theory's autonomy principle. Concurrently, fragmented narrative clues and non-linear storytelling architectures synergize with latent agency mechanics to sustain immediate feedback loops.

Art as Experience

John Dewey's seminal 1934 treatise Art as Experience crystallised his pragmatist aesthetics, positing art as a dynamic interplay of interaction, sensory perception, and affective cognition. This process unfolds within environmental contexts where audiences co-create artistic meaning through dialogic engagement. Dewey rejected elitist art paradigms, instead framing artistic expression as rooted in quotidian experiences and mediated through external forms—a monistic framework guiding affective-aesthetic integration. His philosophy reveals humanity's innate, evolving aesthetic pursuit, adaptively transcending traditional boundaries through rhythmic interplay between memory, knowledge, and nature's reconfigured temporalities (Tan, 1999; Gao, 2022).

Subsequent scholarship expands Deweyan insights:

- Dreon (2021) reconceptualizes cognitive formation as non-linear cognitive scaffolding shaped by cultural-linguistic environmental interactions, advocating holistic analytical paradigms.

- Paulsen (2020) systematizes Dewey's experiential process into four phases:
    1. Attentional perception: Mobilization of multisensory resources to decode focal stimuli.
    2. Categorical perception: Schema-driven classification of novel experiences influencing interpretive frameworks.
    3. Reflective meaning-making: Recursive intuition-reason interplay generating metaphorical saturation.
    4. Creative transculturation: Adaptive knowledge hybridization in unfamiliar cultural milieus.

Game aesthetics primarily manifest through environmental construction and elemental design, serving as multisensory stimuli that engage players' visual and auditory faculties. As players adapt to and cognitively process game environments, they instinctively mobilise heightened cognitive resources to decode and appreciate these spaces. When encountering meticulously crafted interfaces, terrain

systems, and equipment mechanics that surpass anticipatory schemas, players' evaluative baselines for subsequent narrative and gameplay experiences become elevated.

The second dimension emerges through the dialectical interplay between game mechanics/level design and player interaction—a cyclical synthesis of undergoing (receptive perception) and doing (agentic manipulation). This iterative process generates novel experiential knowledge, achieving cognitive saturation through progressive refinement that culminates in emotionally gratifying immersion.

The final layer resides in hermeneutic exploration of narrative subtexts, particularly within culturally dense content. Such abstract representations activate epistemic curiosity, compelling players to excavate tacit knowledge through personalized interpretive frameworks. While comprehension stratification inevitably occurs, sustained engagement facilitates framework recalibration—comparative analysis between initial and terminal gameplay phases reveals relative cognitive saturation, enabling individualized artistic actualisation within reconstituted understanding paradigms.

Reciprocal Determinism

The concept of social perception was first introduced by J.S. Bruner in 1947, with subsequent theoretical advancements culminating in the formulation of Social Cognition Theory (SCT). Albert Bandura's reciprocal determinism within SCT elucidates the tripartite interdependence of personal factors, behavioral factors, and environmental factors in shaping cognitive outcomes. Personal factors encompass self-efficacy assessments and belief systems activated during task engagement. Behavioral factors relate to anticipated rewards—whether tangible (material gains) or intangible (psychological fulfillment)—motivating goal-directed actions. Environmental factors derive from sociocultural milieus (familial, communal, or institutional) that collectively forge cognitive reservoirs influencing problem-solving strategies (Bandura, 2001). This triadic reciprocity underscores cognitive complexity, wherein alterations in any single factor propagate cascading adjustments across the system. The framework further highlights observational learning mechanisms, whereby individuals refine behaviors through modeling successful precedents.

In gaming contexts, players' success expectancy emerges from dual vectors: intrinsic confidence in skill mastery and extrinsic narrative/NPC-driven incentivisation. Externally, communal knowledge-sharing platforms and peer modeling further amplify achievement anticipation through reflective observation. Once crystallized, such expectancy becomes a self-reinforcing catalyst for sustained adaptive engagement, driving iterative cycles of skill refinement and experiential optimization.

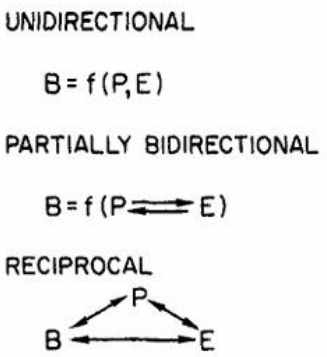

Figure 4. Schematic representation of three alternative conceptions of interaction. B signifies behavior, P the cognitive and other internal events that can affect perceptions and actions, and E the external environment (Bandura, 1978)

Cultural Heritage Preservation and Development

Participatory Culture

Henry Jenkins' 1992 conceptualisation of participatory culture—a media paradigm emerging from digital networked environments—describes communities where cultural citizens naturally engage in content creation, sharing, and co-construction. This framework comprises five defining attributes:

1. Barrier-free engagement: Core to its ethos is democratized artistic expression, enabling participants to interact with existing content while generating novel contributions that reshape collective outputs.
2. Community incentivisation: Collective validation mechanisms encourage marginalized voices to contribute, with shared ownership fostering exponential participation growth through positive feedback loops.
3. Informal mentorship: Affinity spaces replace formal pedagogy, utilizing peer evaluations, exemplars, and communal ethos to guide novices without stifling innovation.
4. Value co-creation: Participants evolve into stakeholders, intrinsically motivated to sustain engagement through perceived personal/cultural dividends.
5. Networked interdependence: Contributors monitor their impact on others, anticipating reciprocal feedback to refine collaborative outputs (Jenkins, 2009). This cultural shift redefines production/consumption dynamics through collective intelligence, fundamentally reconceptualising cultural meaning-making (Bloustien, 2008; Allen et al., 2014).

Game audiences expand by synergistically engaging intra-cultural and cross-cultural players. Intra-cultural communities strengthen through identity reinforcement within affinity spaces, where deepening participation correlates with heightened loyalty. Cross-cultural bridging necessitates converting external players into stakeholders via positive feedback on their artistic expressions during

gameplay interactions. This dual engagement strategy cultivates hybridized environments of informal mentorship and collaborative co-creation.

Narrative Transportation

Green's groundbreaking conceptualization of narrative transportation in 2000 captures a psychological phenomenon where individuals, when fully immersed in narrative experiences analogous to flow states, undergo transformative shifts in preexisting beliefs, identities, attitudes, and behaviors. This mechanism underscores narrative's formidable persuasive power—independent of factual veracity—in establishing enduring cognitive frameworks resistant to alteration (Green & Brock, 2000).

The operational dynamics of narrative transportation involve four interrelated psychological processes. The suppression of critical cognition forms its foundation, as the transportation state functions as a cognitive reward, incentivizing individuals to suspend analytical scrutiny voluntarily.

This perpetuates narrative acceptance when stories exhibit partial alignment with existing value systems, thereby solidifying unexamined endorsement. Concurrently, character persuasion operates through audiences' subconscious idealisation of beloved protagonists, where cognitive embellishment transforms these characters into credible internalized information sources.

Embodied simulation further amplifies narrative impact by generating vivid pseudo-memories through role embodiment—mental constructs rationally discernible as fictional yet emotionally resonant due to their phenomenological richness. Complementing these mechanisms, affective conditioning leverages culturally embedded historical elements to heighten emotional arousal, motivating autonomous exploration of narrative-constructed virtual environments (Li et al., 2015; Green, 2006).

Within gaming contexts, narrative transportation manifests through synergistic interactions among plot, character, and environmental design. Players develop simulated memories under plotline influences, their value systems reshaped through the dual transmission of explicit and tacit knowledge, enabling the deconstruction of cultural stereotypes and fostering authentic cultural identification.

Player-controlled avatars and positively framed non-player characters (NPCs) serve as behavioral archetypes, their admired traits inspiring post-game mimetic practices through parasocial engagement. Spatial design intensifies this process through multisensory environmental stimuli—dynamic lighting, diegetic soundscapes, and interactive artifacts—that induce perceptual immersion. Within these illusionary yet affectively potent environments, persuasive efficiency escalates, driving

players to actively decipher cultural subtexts through exploratory engagement with embedded narrative clues.

Conclusions

This paper proposes a conceptual framework for guiding future serious game design, built upon an in-depth analysis of four theories related to player experience and cultural heritage conservation. The framework consists of three core concepts:

- Triadic Coupling-driven Contextualization: Aims to direct early-stage game mechanics design by ensuring virtual context realism and immersion through advanced technologies, laying the foundation for subsequent cultural implantation.
- Pluralistic Cultural Epistemology: Advocates integrating cross-cultural perspectives into design, encouraging co-creation among groups with diverse cultural backgrounds and knowledge levels to promote broader and deeper cultural heritage dissemination.
- Subject-agentic Aesthetic Narration: Focuses on enhancing player experience by strengthening control perception in interactions and improving overall aesthetic quality, thus achieving profound personalized engagement.

As a conceptual framework for guiding future practices, it offers systematic insights for game developers to design serious games centered on cultural heritage preservation and experience, assisting in effectively embedding cultural content into gameplay. Simultaneously, it provides new perspectives for researchers, particularly in integrating CCD into serious game research. The framework encourages future studies to prioritize player participation processes and states, utilizing tools like flow theory for evaluating and iterating game designs, thereby clarifying the immense potential and inherent limitations of serious games in cultural communication.

Future Work

Future research should focus on the practical validation of this framework, including the development of serious game prototypes based on the framework and rigorous user testing with multiple prototype iterations to assess its practical effectiveness in player experience, cultural communication, and heritage conservation. Thus, we intend to use the UE5 engine to develop a game, employ exploratory sequential design to collect data, and conduct empirical research on the framework through data analysis, laying the foundation for continuous iterative improvement.

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