

Digital Healing of Intangible Cultural Heritage: AIGC-Driven Craft Intervention for Elderly Cognitive Health

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Abstract: Addressing the dual challenges of global aging and endangered intangible cultural heritage(ICH) inherit , this study proposes an innovative "Digital Healing of ICH" theoretical framework. It explores Generative Artificial Intelligence(AIGC) as a core driver to transform ICH crafts into novel cognitive health interventions for older adults, with flow theory providing psychological insights into immersive craft experiences. The research identifies limitations in current art therapy(lack of personalization), ICH digitization(overemphasis on preservation over application), and digital health interventions(cultural shallowness). Employing design-based research and exploratory sequential mixed methods, it develops an AIGC-powered personalized ICH craft intervention prototype, with plans for a 12-week randomized controlled pilot involving older adults with mild cognitive impairment, incorporating multi-dimensional data collection. As a "cultural-cognitive scaffold," AIGC converts collective cultural memory into personalized visual symbols, fostering emotional resonance. This empowers older adults to construct positive self-narratives, strengthen social connections, and transition from passive treatment to active meaning-making. The framework bridges disciplinary divides, offering integrated approaches for art therapy, cognitive health promotion, and ICH revitalization, providing interdisciplinary solutions for aging and cultural heritage activation. Innovative AIGC applications in cultural heritage offer new pathways for ICH vitality, enhancing accessibility and interactivity through digital twins and immersive experiences.

Keywords: Digital healing; Generative Artificial Intelligence(AIGC); Intangible cultural heritage; Craft intervention; Elderly cognitive health; Art therapy; Design-based research

I. Literature Review

A. Theoretical critique, and research gaps

Digital visual art interventions positively impact cognitive function in healthy older adults, emerging as effective tools for cognitive health promotion.

This chapter systematically reviews three intersecting domains: ICH craft therapy, AIGC applications in cultural heritage, and digital cognitive interventions for older adults. By

analyzing research progress and core issues, it identifies knowledge gaps to establish that Generative Artificial Intelligence(AIGC) is transforming cultural heritage research and practice, evolving from early digital archiving tools to vehicles for creative generation and experience construction. Practically, AIGC facilitates ICH digital twins, cultural product design, and immersive experiences, democratizing ICH from professional inheritance to public participation. Academically, scholars explore

AIGC's collaborative creation value—assisting families with multimodal narrative production and providing personalized cultural memory visualization for older adults—establishing AIGC as a novel creative medium bridging collective heritage and individual expression. AI-driven multimodal photo album studies demonstrate enhanced recall quality and emotional experiences in cognitively intact older adults through personalized content presentation.

However, significant physical divides exist in current AIGC cultural heritage applications, with innovations predominantly confined to digital virtual spaces producing screen-displayable content disconnected from hands-on, physical craft creation. This creates a research gap: how to transform AIGC-generated digital content with personal/cultural significance from final outputs into foundations for guiding offline physical craft practice. No systematic theoretical model currently explains this digital-to-physical conversion mechanism or value cycle. ICCROM reports emphasize AI's central role in cultural heritage digitization, noting the need for technological intermediaries to balance innovation and cultural authenticity.

B. Digital cognitive health interventions for older adults: Imbalances between technical efficiency, cultural warmth, and social connection

In geriatric health, AI-based cognitive training programs and digital therapies are rapidly developing. These interventions, centered on standardized cognitive tasks, offer quantifiable outcomes and replicability, showing efficacy in targeted cognitive domains, particularly working memory enhancement.

However, they face significant limitations in addressing the multifaceted emotional, identity, and social well-being requirements of older adults. Three criti-

cal shortcomings emerge: cultural and personal disconnection, where standardized content fails to align with diverse cultural backgrounds and life experiences, undermining sustained engagement; limited social interactivity, as human-computer interaction models impede interpersonal connection, potentially worsening isolation and inadequate integration of emotional feedback mechanisms. While AIGC painting applications show promise in boosting immersion, positive affect, and self-efficacy by minimizing creative frustration, their incorporation into culturally enriched activities demands further exploration.

C. Research gaps and theoretical framework

Cross-disciplinary analysis reveals two fundamental research gaps: first, the fragmented relationship between personalized cultural symbol generation and embodied practice, with current studies failing to integrate highly individualized cultural content creation with multisensory physical craft activities, thus underutilizing AIGC's capacity to generate culturally resonant symbols tailored to personal narratives for guiding offline manual creation; second, the lack of integrated technology-culture theoretical models addressing singular value dimensions, where digital health interventions often lack cultural warmth and social elements, while cultural therapeutic approaches insufficiently target cognitive function—resulting in an absence of systematic frameworks that synthesize technical mediation, cultural translation, physical engagement, and the cognitive-emotional-social outcomes in older adults.

To address these limitations, this study integrates cutting-edge SSCI journal perspectives, including user-centered design, personalization, and social ethical considerations, to propose the "AIGC-Mediated Cultural-Embodied Practice Mod-

el" as its central theoretical framework. By positioning AIGC as an intelligent cultural intermediary, this framework transforms intangible cultural heritage into highly personalized visual symbols that are systematically integrated into immersive physical craft creation, establishing a cyclical process of "digital instruction-physical execution-meaningful feedback." This approach simultaneously optimizes multidimensional health outcomes for older adults and revitalizes intangible cultural heritage in contemporary contexts, offering interdisciplinary solutions to the challenges of aging populations and cultural heritage preservation.

II. Theoretical Framework Construction: AIGC-Mediated Cultural-Embodied Practice Model

This chapter elaborates the core theoretical contribution: the AIGC-Mediated Cultural-Embodied Practice Model. This integrative framework explains and guides the creative transformation of ICH resources into geriatric health interventions through technical mediation, addressing identified research gaps and providing systematic analytical tools to bridge theoretical barriers across ICH therapy, AIGC applications, and digital health.

A. Theoretical positioning and core concept definition

The model is grounded in sociocultural theory and embodied cognition theory. From a sociocultural perspective, higher psychological functions develop through cultural tool mediation; this framework positions AIGC as an intelligent cultural tool bridging individuals and ICH systems. From an embodied cognition perspective, cognition emerges through real-time bodily-environmental interactions, making craft practice integral to cognitive and emotional forma-

tion rather than merely artistic expression.

Based on these theories, core concepts are defined as follows:

(1) **Intelligent Cultural Intermediary:** AIGC's central role, distinct from passive content generators, dynamically producing personalized cultural symbols by integrating individual inputs (life story keywords, emotional states) with cultural contexts (ICH aesthetic paradigms, symbolic systems).

(2) **Personalized Cultural Symbol Infusion:** AIGC's critical output, integrating visually symbolic content with both personal meaning and cultural significance into subsequent craft creation processes as meaning-laden blueprints for practice.

(3) **Cultural-Embodied Practice Cycle:** The complete process from digital symbol generation to physical craft production and meaning-based feedback, emphasizing bidirectional interactions between digital/physical domains, thought/action, and individual/cultural levels—representing the model's dynamic operational structure.

B. Three mechanisms of AIGC as an "Intelligent cultural intermediary"

This model identifies three key mechanisms through which AIGC functions as an intelligent cultural intermediary, addressing core limitations in existing research:

(1) **Mediating Cognitive and Creative Load:** To address challenges of creative anxiety and high cognitive burden among older adults, AIGC transforms abstract memories and cultural imagery—difficult for seniors to directly conceptualize and visualize—into concrete, perceptible, and actionable visual drafts. This significantly lowers cognitive barriers to creative ideation, allowing older adults to allocate mental resources toward reflecting on personal meaning and executing manual techniques, thereby

facilitating deep cultural engagement.

(2) **Mediating Cultural Memory and Individual Emotion:** To overcome the lack of cultural warmth and weak personal relevance in digital health interventions, AIGC establishes a dynamic translational bridge between collective ICH symbol repositories and individual life experiences. By deconstructing, reorganizing, and reimagining cultural elements, it generates visual narratives that resonate emotionally with specific individuals, effectively evoking positive affect while embedding new positive autobiographical memories into created works, thereby strengthening cultural identity and self-continuity among older adults.

(3) **Mediating Social Interaction and Meaning Sharing:** To address the weak social attributes of digital interventions, AIGC-generated personalized works carry distinct narrative qualities. In group intervention settings, these creations serve as vehicles for elderly individuals to communicate, share experiences, and build empathy, facilitating a shift from personal introspection to social connection and integrating creative activities into supportive networks rooted in shared cultural frameworks and life stories, self-identity, and identification with shared cultural frameworks..

C. Pathway model of the "Cultural-embodied practice" Cycle

Central to this theoretical framework is the development of a clear, operational pathway model for the cultural-embodied practice cycle, which

articulates the complete logic from problem input to achieving the dual goals of healing and heritage preservation:

(1) **Input and Translation Phase:** Leveraging dual inputs—older adults' life narratives, current emotional states, and ICH cultural databases—with AIGC serving as the core algorithmic engine, this phase accomplishes cultural translation and personalized generation, ultimately producing craft blueprints that balance cultural authenticity with individual uniqueness.

(2) **Embodied Execution Phase:** The generated blueprints are applied to physical craft creation, where older adults engage cognitive, perceptual, and motor systems through cutting, carving, sewing, dyeing, and other manual operations, transforming digital symbols into tangible artifacts. This process integrates abstract meaning with bodily experience and material existence, representing the critical physiological and psychological mechanisms underlying therapeutic effects.

(3) **Cycle Closure and Optimization Phase:** The creative process and final artifacts generate multidimensional feedback regarding operational fluency, emotional experiences, and social interactions. This feedback informs refinements to AIGC generation strategies and adjustments to craft task design, establishing a continuously improving research-practice cycle. This simultaneously achieves the dual objectives of enhancing older adults' individual well-being and exploring contemporary forms of ICH inherit.

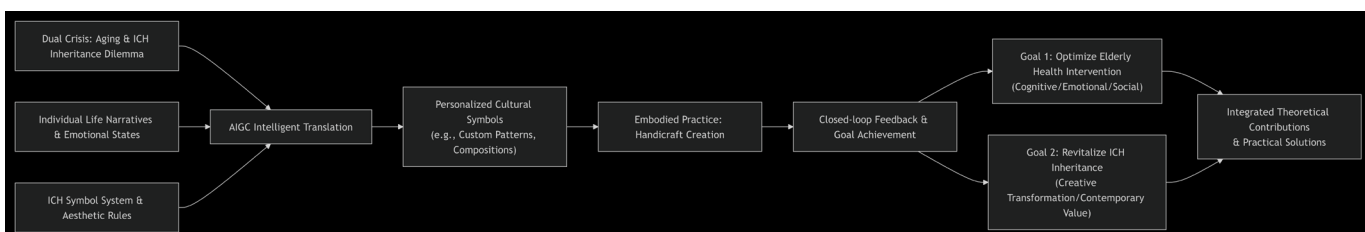


Figure 1 Practice Model Map

D. Theoretical and practical significance of the framework

The theoretical significance of this model lies primarily in its integrative and predictive capacity, synthesizing core variables from art therapy, human-computer interaction, cultural heritage studies, and geriatric psychology into a unified logical framework. It clearly articulates relationships and operational pathways between variables, providing testable hypotheses for subsequent empirical research—for instance, predicting that the personalization level of cultural symbols positively correlates with emotional resonance and cognitive improvement outcomes in older adults.

Practically, the framework offers clear design principles and evaluation dimensions for developing geriatric cognitive health interventions, guiding practitioners to focus not only on the aesthetic completion of craft works but also on the meaningful relevance of AIGC-generated content, the physical engagement in craft practice, and the social generativity of group activities. This framework establishes a shared conceptual language and goal orientation for interdisciplinary collaboration, providing an innovative yet actionable theoretical approach to addressing the dual challenges of aging populations and cultural heritage preservation.

III. Research Design and Methodology

This chapter systematically elaborates the comprehensive research protocol for validating and refining the AIGC-mediated cultural-embodied practice model. To bridge theoretical construction and practical validation, this study employs design-based research (DBR) and an exploratory sequential mixed methods approach, developing intervention prototypes that balance theoretical rigor, technical feasibility, and cultural appropriateness through multiple iterations, while establishing a

rigorous methodological foundation for evaluating intervention outcomes.

A. Design-based research and mixed methods approach

This research adopts design-based research (DBR) as its core methodology. This paradigm advances educational practice and develops design principles through iterative cycles of design, implementation, analysis, and revision in authentic contexts. It aligns with the central objective of constructing, testing, and refining an integrated model and intervention program, facilitating multiple design-implementation-evaluation-redesign cycles to ensure both innovation and practical viability of research outcomes.

To comprehensively capture the complexity of intervention processes and the multidimensionality of outcomes, this study employs an exploratory sequential mixed methods design following a qualitative-first, quantitative-follow approach: Phase one utilizes qualitative methods to understand older users' cultural needs, technological perceptions, and experiences; Phase two designs and implements a quantitative quasi-experiment based on qualitative findings to preliminarily test intervention effectiveness; Phase three reintegrates qualitative data to provide contextualized interpretation and in-depth analysis of quantitative results. This sequence grounds research in authentic user needs while enabling preliminary inferential testing of intervention effects.

B. Contextual needs analysis and prototype co-design

1. Qualitative needs assessment and ethical foundation

Prior to formal intervention prototype development, a small-scale qualitative pilot study will be conducted using semi-structured interviews and

participant observation with three groups: older adults with mild cognitive impairment, ICH inheritors, and geriatric care specialists. This will explore older adults' life experiences, cultural memories, craft backgrounds, attitudes toward and acceptance of AIGC technology, alongside ICH inheritors' interpretations of core techniques, cultural symbols, and teaching priorities. All research procedures will be approved by the institutional ethics review board, with strict implementation of informed consent and data confidentiality principles to ensure compliance with academic ethical standards.

2. Participatory co-design workshops

Based on qualitative needs assessment results, an interdisciplinary design team will be formed, comprising experts in art education, artificial intelligence, rehabilitation gerontology, and ICH, along with representatives of potential elderly users. This team will conduct 2-3 structured co-design workshops focused on translating abstract user needs into specific technical specifications and intervention elements—such as collaboratively determining AIGC model input parameters, output formats, and transfer mode between digital outputs and physical craft material kits. These workshops will culminate in design principles and prototype system specifications for AIGC-driven ICH therapeutic interventions.

C. Intervention program development and feasibility validation research design

1. Prototype system development and iteration

In accordance with prototype system specifications, a functional AIGC tool prototype will be developed based on a fine-tuned open-source generative model. The prototype will feature a simplified interface enabling facilitators to input keywords, select ICH styles, and generate personalized pattern sketches for older adults to choose from and refine. Development will adopt an agile methodology with

close feedback loops with the design team, incorporating multiple rounds of usability testing and iterative optimization.

2. Randomized controlled pilot study protocol: Validating the "Digital-physical" Cycle

A 12-week randomized controlled pilot experiment will be conducted with the primary objectives of testing the feasibility and safety of the AIGC-driven ICH craft intervention program, while gathering preliminary evidence to validate the effectiveness of the core "personalized digital generation guiding physical practice" cycle. The experimental design will strictly follow CONSORT guidelines for reporting feasibility trials.

1) Participants

Recruitment and Sample Size: Participants will be recruited through collaborations with local community senior centers, community health service centers, and ICH museums. A total of 48 participants are planned, with a 20% attrition rate considered to ensure at least 16 valid cases per group. Block randomization will be used to allocate eligible participants to three groups at a 1:1:1 ratio using computer-generated random sequences, ensuring baseline equivalence across groups.

Inclusion Criteria: Aged ≥ 60 years; meeting Petersen's clinical diagnostic criteria for mild cognitive impairment; Montreal Cognitive Assessment (MoCA) Beijing version score of 18-26 (adjusted for education level); visual, auditory, and upper limb motor function sufficient for basic craft activities; ability to provide informed consent and voluntary participation.

Exclusion Criteria: Confirmed diagnosis of dementia or other major psychiatric/neurological disorders; severe or unstable physical illness; regular participation in other structured art therapy or cognitive training programs in the past 6 months.

Ethical Considerations: The study protocol

has been approved by the university ethics review committee. All participants will provide written informed consent, be informed of their right to withdraw unconditionally at any time, and all research data will be anonymized.

2) Intervention protocol

All three groups will participate in 12 weekly

90-minute structured group craft sessions led by the same trained facilitator and assistant in a fixed, quiet community activity room. The sole difference between groups will be the source of creative blueprints and medium of creation, allowing isolation and testing of independent and combined effects of personalization and embodied practice.

Table 1 Comparison of Intervention Protocols

Group	Group Name and Design Purpose	Blueprint Source	Practice Medium	Key Operational Procedures
Experimental Group(EG)	AIGC-Personalized Physical Group Testing "personalization+physical" cycle	AIGC-generated personalized patterns	Physical materials(paper, fabric, Needle and thread, etc.)	<ol style="list-style-type: none"> 1. Narrative Elicitation: Facilitator helps abstract personal life keywords(e.g., "hometown river," "mother's gardenia"). 2. Collaborative Generation: Input keywords and selected ICH style(e.g., "Northern Shaanxi paper-cutting") into AIGC tool to generate 3 sketches for participant selection and refinement. 3. Physical Translation: Convert final pattern into laser-cut stencil or heat transfer template. 4. Embodied Creation: Perform physical creation(cutting, carving, embroidery) based on physical template.
Control Group A(CA)	Fixed Pattern Physical Group Controlling "physical activity" and "social" effects	Predefined generic ICH pattern library	Physical materials(same as EG)	<ol style="list-style-type: none"> 1. Pattern Selection: Choose one design from the same themed but fixed pattern library as EG. 2. Standard Production: Create using same physical templates and materials as traditional crafts.
Control Group B(CB)	AIGC-Personalized Digital Group Isolating "personalization" effect, testing necessity of "physical" component	AIGC-generated personalized patterns(same as EG)	Digital tablet and stylus	<ol style="list-style-type: none"> 1. Generation Process: Same as EG steps 1-2 to obtain personalized digital pattern. 2. Digital Drawing: Trace and color the pattern using stylus on tablet drawing application without physical translation or production.

Example Curriculum Content for Paper-Cutting Theme Unit:

Weeks 1-3(Initiation and Foundation): Theme "My Symbols" – EG generates personal life symbols and completes paper-cutting; CA learns traditional patterns and completes paper-cutting; CB generates personal symbols and creates digital drawings;

Weeks 4-8(Deepening and Narrative): Theme "Scenes from Memory" – EG generates composite patterns integrating personal stories and local elements for multi-layered paper-cutting; CA learns classic scene paper-cutting; CB generates scenes and creates digital drawings;

Weeks 9-12(Integration and Expression): Theme "Our Stories" – Group collaboration to complete an integrated artwork, with EG members contributing and montage personal pattern components,

CA using fixed pattern library elements for montage, and CB contributing and synthesizing digital pattern components.

3) Measurement and data collection(multidimensional assessment framework)

Data collection will address three dimensions: feasibility, process mechanisms, and preliminary effectiveness, utilizing mixed methods.

Feasibility and Safety Indicators(Primary Outcomes): Recruitment capacity, measured by monthly recruitment numbers and screening pass rates; protocol acceptability, measured by intervention retention rate(target $\geq 80\%$) and session completion rate, with technology tool usability assessed post-intervention using the System Usability Scale(SUS); safety, documented through recording of all adverse events and related management measures.

Table 2 Preliminary Efficacy and Mechanism Indicators(Secondary Outcomes)

Assessment Dimension	Measurement Tool/Method	Assessment Time Point	Corresponding Theoretical Mechanism
Cognitive Function	Montreal Cognitive Assessment: Total score with subitems of visuospatial/executive function, naming, and delayed recall.	Baseline(T0), post-intervention(T1)	Cognitive-Affective Outcomes
Emotional State	Geriatric Depression Scale-Short Form, State Anxiety Inventory.	T0, T1, post-each session(emotional assessment)	Cognitive-Affective Outcomes
Creative Flow and Engagement	Short Flow State Scale(9 items) assessing concentration, enjoyment, and time distortion	Post-each session	Embodied Practice Process
Self-efficacy and Cultural Identity	Self-developed scale: Perceived craft self-efficacy(4 items), ICH cultural sense of identity(3 items).	T0, T1	Personalized Cultural Infusion
Social Interaction Quality	Behavioral observation coding: Video recording of sessions, coding frequency and duration of three positive interaction types("active personal story sharing", "substantive assistance provision", "emotional support expression") using Noldus Observer XT software.	3rd, 6th, 9th, 12th sessions	Social Interaction Mediation
Personal Meaning and Aesthetic Characteristics of Artworks	1. Qualitative interviews: Semi-structured interviews with EG and CB groups post-intervention focusing on personal relevance of patterns and memory evocation during creation. 2. Blind artwork evaluation: Three experts in art therapy and ICH(blinded to group allocation) rating artworks on 7-point Likert scales for narrative uniqueness, emotional resonance, and cultural integration(inter-rater reliability assessed via Cronbach's α).	Within one week after T1	Outcome Manifestation of Personalized Cultural Infusion

Process data: AIGC interaction logs recording keywords used, modification frequency, and selection preferences for each pattern generation session in experimental and control Group B to analyze personalization patterns; field observation notes documenting participants' typical behaviors, verbal expressions, and special incidents involving technology and material interactions.

4) Data analysis plan

Feasibility analysis: Descriptive statistics will report recruitment, retention, completion rates, and SUS scores(>68 indicating "good usability");

Preliminary efficacy analysis: Primary analysis will follow intention-to-treat principles. For continuous variables including MoCA scores and flow metrics, mixed linear models will examine "time × group" interaction effects to test differences in change trends across three groups. Categorical variables will use chi-square tests. Key comparisons include: if experimental group outperforms Control A, demonstrating advantages of personalized over standardized content; if experimental group outper-

forms Control B, indicating additional value of physical practice versus digital drawing under equivalent personalization; if Control B outperforms Control A, solely verifying benefits of personalized content;

Mechanism and qualitative analysis: Correlational and mediational pathway exploratory analyses will be conducted on variables including blind artwork ratings, flow scores, and social interaction frequency; Braun & Clarke's reflective thematic analysis will be applied to interview transcripts to extract themes such as technological experience and self-narrative reconstruction, interpreting and enriching quantitative findings.

D. Mixed data analysis and theoretical model refinement

1. Data analysis strategy

Quantitative analysis will employ descriptive statistics to examine feasibility indicators, using repeated measures ANOVA to compare group-time interaction effects on cognitive and emotional scale scores for preliminary intervention efficacy evaluation. Qualitative analysis will apply reflective thematic analysis to

interview transcripts and observation notes, extracting core themes including cultural identity, technological experience, self-efficacy, and social connection, while conducting visual analysis of artworks to interpret their narrative and personal expressive dimensions.

2. Mixed integration and theoretical iteration

This phase represents the core of the design-based research paradigm. Through in-depth integration of multiple rounds of data and evidence, it will test, interpret, and refine the initial AIGC-mediated Cultural-Embodied Practice Model. Following the logic of triangulation-interpretation construction-iterative revision, mixed methods integration strategies including joint display, data transformation, and qualitative-driven quantification will be adopted to cross-validate quantitative results with qualitative findings, facilitating theoretical model refinement.

1) Core objective: From data validation to theoretical refinement

Analysis at this stage transcends simple efficacy comparison, focusing on three progressive theoretical questions: First, whether the digital-to-embodied practice loop produces expected effects and its specific operational mechanisms; Second, how core con-

structs in the model—such as personalized infusion and embodied engagement—interact to influence outcomes; Third, how to iteratively optimize the theoretical model and application design based on empirical feedback to enhance its explanatory power, ethical inclusivity, and practical effectiveness.

2) Integrated analysis strategies and theoretical iteration pathways

Verifying "digital-embodied" loop efficacy(quantitative-led, qualitatively interpreted): The analytical strategy will first use mixed linear models to systematically compare differences in key outcome indicators—including flow experience, blind artwork ratings, social interaction frequency, and MoCA subscore changes—across the experimental group, Control A, and Control B. Second, effect decomposition will be performed to determine independent and synergistic effects of personalization and physical practice. Qualitative data will primarily explain quantitative differences, such as extracting relevant themes from interviews to corroborate higher flow scores in the experimental group, and conducting qualitative analysis of social interaction videos to interpret variations in interaction depth across groups.

Table 3 Relational PathwaysTable

Theoretical Construct	Operationalized Indicators	Integration Analysis Strategy	Theoretical Refinement Goal
Personalized Cultural Infusion(X1)	1. Objective: Personalization score of keywords in AIGC logs, pattern modification frequency. 2. Subjective: Self-reported pattern relevance intensity from interviews, "narrative uniqueness" score from blind artwork evaluation.	1. Correlational analysis: Calculate composite X1 Index and Correlation "flow experience" and "emotional changes". 2. Qualitative categorization: Classify participants into "high resonance" and "low resonance" groups based on interviews, comparing differences in subsequent process and outcome indicators.	Identify effective components of "personalization"(e.g., keyword privacy vs. personal historical relevance of visual elements).
Embodied Practice Engagement (X2)	1. Behavioral: Operational fluency(interruption frequency from video analysis), task persistence duration. 2. Physiological: Heart rate variability reflecting concentration. 3. Subjective: "Sense of control" subdimension from flow scale.	1. Mediation analysis exploration: Conduct exploratory path analysis with X1 as independent variable, X2 as mediator, and cognitive-emotional improvement as dependent variable. 2. Qualitative sequence analysis: Analyze "encounter difficulty-seek solution-achieve success" narrative sequences from interviews to understand how embodied engagement constructs self-efficacy.	Clarify whether embodied practice functions as a "mediator" or "moderator"(e.g., does it strengthen the effect of personalized infusion?).
Cognitive-Affective-Social Outcomes(Y)	MoCA subscores, emotional scale scores, social interaction coding scores, self-efficacy ratings.	Joint display: Create case presentation boards juxtaposing all quantitative scores, key interview quotes, and artwork photos for a participant's X1→X2→Y pathway, forming a "thick description" of the mechanism chain.	Reveal interrelationships between outcome dimensions(e.g., does social interaction improvement precede emotional enhancement?).

Identifying ethical and cultural adaptability issues(qualitative-led, driving quantitative revisions): The analytical strategy involves thematic analysis of interview and observation data concerning technological experience, cultural identity, and ethical perceptions, focusing on three dimensions: algorithmic bias, sense of empowerment and autonomy, and boundaries between cultural authenticity and innovation. Analysis results will inform specific design adjustments, including optimizing AIGC prompt libraries, refining intervention protocols, and elaborating ethical guidelines, culminating in a draft "Ethical Guidelines for AIGC Cultural Applications with Elderly Populations".

3) Specific outcomes of theoretical iteration

Incorporating moderator variables such as initial cognitive level into existing pathways, clarifying mediating pathways like embodied practice engagement, and providing preliminary effect size estimates for key model chains;

Formulating design principles balancing cultural adaptability and practicality, proposing more refined testable research propositions to guide subsequent empirical studies.

IV. Discussion, Application Prospects, and Research Boundaries

This chapter contextualizes the study's theoretical framework and preliminary empirical findings within broader academic, social, and technological landscapes. It synthesizes theoretical and practical contributions, systematically elaborates on practical potential as social-technical design, ethical challenges, and future research directions, presenting a critical, constructive, and forward-looking research perspective.

A. Theoretical contributions: Beyond integration, toward a "Social-technical-cultural" Synergistic framework

The core theoretical contribution lies not in

simply integrating research on ICH, health, and AIGC, but in constructing a "social-technical-cultural" mediation model explaining their synergistic mechanisms. Its innovations manifest in three aspects:

Addressing and advancing core academic debates: The model effectively bridges the gap between technical efficiency and humanistic care in digital health by infusing personalized cultural elements, endowing digital health interventions with cultural warmth and personal meaning. Simultaneously, it resolves the physical divide between digital twins and living heritage transmission in cultural digitization, repositioning AIGC from a creative endpoint to a starting point for physical practice, offering operational and verifiable theoretical pathways that transcend single-process limitations of most existing research.

Providing extensible methodological grammar: Rooted in design-based research, this study demonstrates a methodological system for iteratively constructing and validating interdisciplinary interventions—including balancing technical feasibility with cultural authenticity through co-design, isolating active components via multidimensional control groups, and capturing complete effect chains using mixed methods. This methodology offers a reusable template for similar studies across cultural contexts and health populations.

Deepening embodied cognition and media theory in the digital age: The model validates the effectiveness of digitally guided embodied practice, where older adults' cognitive, emotional, and social capacities are profoundly shaped through transforming personalized, meaningful digital symbols into physical artifacts via manual labor. This conclusion enriches understanding of how digital intermediaries reshape human experience and expands the extension and connotation of embodied

cognition.

Research on embodied cognition applications in technology-enhanced learning for older adults provides theoretical foundation for the model's physical practice mechanisms.

B. Practical application prospects: Translation pathway from research prototype to inclusive social innovation

The framework presents clear practical translation logic capable of fostering sustainable, scalable, and ethical social innovation, primarily manifested in two dimensions:

Studies on the positive health impacts of arts demonstrate that creative activities improve older adults' overall well-being.

Developing an open, adaptable "Digital Therapeutic Toolkit": Upon research maturation, core outcomes will be integrated into an open-source or knowledge-sharing ICH digital therapeutic toolkit. Rather than a single activity manual, this toolkit constitutes a multi-layered ecosystem encompassing technical, content, and ethical-evaluative components. The technical layer provides AIGC model fine-tuning guidelines and simplified interface code; the content layer includes modular ICH-themed curriculum packages, cultural symbol prompt libraries, and task difficulty adjustment protocols; the ethical-evaluative layer features participatory design workshop procedures, ethical risk assessment checklists, and standardized assessment tools. This openness empowers community workers, cultural institutions, and families while engaging global peers in iterative development, forming a living knowledge community. Applications of VR/AR technologies in cultural heritage museum services have significantly enhanced visitor experience and satisfaction, providing technical reference for this study's digital-physical integration design. For instance, the "Huaxia · Qiyun · Shengjing" intelligent

interactive installation developed by the Shanghai Conservatory of Music's Key Laboratory of AI Music Therapy offers technical Practical Reference for ICH-based therapeutic interventions through art-science integration. GAN applications in Yunjin brocade digital smriti have validated AIGC's feasibility for ICH pattern innovation.

Developing a Sustainable Social Innovation Model of "Empowerment-Participation-Symbiosis": To prevent intervention projects from becoming short-term experiments, this study explores endogenous sustainable mechanisms by constructing a triple helix model. First, community empowerment involves training community cultural health facilitators to independently operate workshops, integrating interventions into regular elderly services. Second, value cycling entails collaborating with social enterprises—under the principles of informed consent and benefit-sharing—to develop small-batch, high-value cultural products or digital collectibles from elderly participants' creations. Revenue is partially reinvested in project operations and partially allocated to creators, forming a virtuous cycle of social, cultural, and economic value. Third, cultural symbiosis transforms intangible cultural heritage(ICH) inheritors into community creative consultants, enabling their knowledge systems to gain contemporary interpretation through AIGC and emerging social needs. Concurrently, elderly individuals transition from service recipients to co-creators and inheritors of cultural narratives, achieving dual integration across generations and roles. The "SKY Right Art" project, which integrates Regong art with AI, demonstrates the potential for collaborative innovation between ICH and technology.

V. Research Boundaries, Ethical Reflections, and Future Directions

As a prospective exploration, this study has

certain boundaries and limitations, which also clarify future research directions:

In-depth Challenges in Technological Ethics: From "bias mitigation" to "cultural negotiation," algorithmic bias represents a superficial issue; the deeper challenge lies in defining cultural interpretive authority—specifically, who should determine the innovative boundaries for AIGC's reorganization of ICH symbols: algorithms, researchers, inheritors, or participants. Future research should incorporate ethical accompaniment studies, integrate anthropological perspectives throughout technological development, establish ongoing negotiation mechanisms with heritage communities, and explore the development of culturally sensitive assessment algorithms for automated preliminary screening of AIGC-generated content. Research on the application of digital art therapy in elderly populations indicates that technology-mediated creative activities can effectively improve psychological states.

The "Black Box" of Long-Term Efficacy and Mechanisms: This preliminary study only verifies the short-term feasibility of the intervention and suggests potential mechanisms, while the long-term effects and pathways of action remain unclear—for example, whether benefits stem from direct transfer of cognitive training or indirect gains through enhanced self-efficacy and social integration. Future research requires large-scale, long-term randomized controlled trials, integrating neuroimaging, physiological measurements, and ecological momentary assessment to uncover the biopsychosocial pathways through which cultural-bodily practices influence brain plasticity and mental health. As a key form of art therapy, music's neurochemical mechanisms provide a biological foundation for understanding the cognitive effects of handicraft interventions. A World Health Organization review

notes that evidence supporting the role of arts in health promotion provides a public health perspective for this study's interdisciplinary framework. Research on cognitive impairment screening tools offers methodological support for the early identification of mild cognitive impairment.

From Specific Cases to Cross-Cultural Generalizability: This study is grounded in specific ICH forms such as paper-cutting and local cultural contexts. Further research is needed to determine whether its core principles can be transferred to other craft traditions like weaving and pottery, and how to dynamically balance personalization and cultural authenticity across diverse cultural contexts. Future comparative studies should refine cross-cultural meta-frameworks, develop accompanying culturally adaptive toolkits, guide researchers and practitioners in different regions in local adaptation, and establish the model as a cross-cultural research paradigm with global dialogue capabilities.

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