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Embodied Cognition and Value Internalization: Generative Logic and Practical Paths of Immersive Red Culture Study Empowered by Digital Intelligence

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Abstract: In the era where digital intelligence technology is deeply intervening in cultural heritage, red culture education is facing a critical opportunity to transform from "disembodied" symbolic inculcation to "embodied" experiential internalization. Traditional red culture study is often limited by a text-centric cognitive paradigm, leading to a disconnection between historical scenes and the physical experience of the learner, making it difficult to achieve deep value resonance. Based on the theory of Embodied Cognition, the body is not only the physiological basis of perception but also the cognitive subject of meaning generation. Digital intelligence technology, by constructing multimodal immersive fields, provides the technological possibility of "being personally on the scene" for red culture study, reconstructing the interactive relationship between the subject and the historical object. This paper aims to analyze the generative logic of immersive red culture study empowered by digital intelligence, explaining how it promotes the transition of the red gene from "physical presence" to "spiritual presence" through spatio-temporal resetting, sensory extension, and situational interaction, ultimately achieving a value leap from perceptual experience to rational identification and then to belief internalization. On this basis, combined with the exploration practices of red cultural resource digitization in Guangzhou and other places, this paper proposes paths for constructing a virtual-real symbiotic embodied narrative system, a multi-dimensional interactive physical participation mechanism, and a technological regulation path of value rationality, providing theoretical support and practical reference for the revitalization of red cultural resources and innovation in ideological and political education in the new era.

Keywords: Embodied Cognition, Value Internalization, Digital Intelligence Empowerment, Red Culture, Immersive Study, Digital Narrative.

1. Introduction

Red culture is an advanced cultural form accumulated by the Chinese people under the leadership of the Communist Party of China in the great practices of revolution, construction, and reform, containing a rich revolutionary spirit and profound historical heritage. General Secretary Xi Jinping has emphasized multiple times: "Tell the stories of the Party, the stories of the revolution, and the stories of heroes well, pass on the red gene, and ensure that the red country is passed down from generation to generation." [1] However, in the long-term practice of red culture education and study, we face a universal pain point: How to cross the barrier of time and space, allowing teenagers growing up in a peaceful era to truly understand and empathize with the hardships and noble beliefs of those war-ridden years?

Traditional red culture education often follows the "cognitivist" teaching paradigm, focusing on the symbolic transmission of historical facts, emphasizing the abstract processing of textual information by the brain, while neglecting the learner's physical experience and emotional participation. This "disembodied" educational mode makes red culture study prone to becoming a cursory tour or boring preaching, where the educatee is in the perspective of a "bystander," making it difficult to generate deep psychological involvement and value identification. Educational psychology research shows that mere symbolic memory struggles to touch the deep emotional centers, and value inculcation lacking an emotional foundation is often fragile and fleeting.

In recent years, with the rapid development of digital intelligence technologies such as the Metaverse, Virtual Reality (VR), Augmented Reality (AR), and Artificial Intelligence (AI), "Immersive Study" has emerged as a new educational form. It attempts to break the limitations of physical time and space through technological means, restoring historical scenes and allowing educatees to perceive history while "being personally on the scene." However, current research and practices on immersive study mostly focus on the "technique" level of technological implementation, lacking a systematic theoretical explanation for the underlying cognitive mechanism and value internalization logic—the "Tao" level. How to avoid immersive study becoming a display of technical skills or shallow sensory stimulation, and truly serve the inheritance of the red gene and the molding of beliefs, is a theoretical and practical proposition that needs to be solved urgently.

The rise of Embodied Cognition theory provides a new epistemological perspective for solving this problem. This theory posits that cognition is not merely neural activity in the brain but is deeply rooted in the interaction between the body and the environment. The structure of the body and the activity patterns of the sensorimotor system determine how we recognize the world [2]. In red culture study, only when the educatee's body truly "enters" the historical field and engages in multi-sensory embodied interaction can deep emotional memories be activated, thereby achieving the effective internalization of values.

This paper attempts to introduce Embodied Cognition theory into the field of red culture study, exploring how digital intelligence technology empowers this process. The article first reflects on the limitations of traditional red education from a theoretical level, establishing the core status of embodied cognition; then deeply analyzes the generative logic of immersive study empowered by digital intelligence, revealing how technology reconstructs the link of "Body-Environment-Meaning"; finally, based on the practical level, it proposes the construction path of immersive red culture study in the digital intelligence era, aiming to provide academic reference for promoting the creative transformation and innovative development of red cultural resources.

2. Theoretical Perspective: Paradigm Shift from "Disembodied" Preaching to "Embodied" Experience

To understand the value of immersive study empowered by digital intelligence, we must first philosophically examine the cognitive paradigm of red culture education and clarify the epistemological shift from "disembodiment" to "embodiment."

2.1. The "Disembodied" Dilemma and Cognitive Limitations of Traditional Red Education

Under the influence of classic Cartesian "mind-body dualism," traditional pedagogy often views the mind as an independent symbol processor, while the body is merely a biological container carrying the mind. Red education dominated by this paradigm presents significant "Disembodiment" characteristics.

First is the symbolization of cognition. Red history is compressed into text in textbooks, pictures on museum panels, and data in the mouths of guides. The learning process becomes the memorization and recitation of these abstract symbols. For example, students may remember the number "25,000-li Long March," but lacking the physical perception of extreme fatigue, hunger, and cold, it is difficult for this number to translate into a real shock of revolutionary will in their hearts. There is a huge experiential gap between symbols and meaning.

Second is the spectatorship of the subject. In traditional visit-based study, history is the object "being displayed," and students are the audience "being isolated." Glass cases block tactile sensation, and cordon lines define distance. This vision-centric single-sensory experience keeps students perpetually "outside" history, unable to establish an "I-Thou" intersubjective relationship; historical figures and events remain objective "Its."

Finally is the superficiality of emotion. Due to the lack of deep bodily participation, the stimulation of emotion often relies on external rhetorical rendering rather than internal experiential generation. Such emotions are often transient and fleeting, difficult to precipitate into a stable value system and belief system.

2.2. Ontological Regression of Embodied Cognition Theory to Red Culture Education

Embodied Cognition theory is a critique and transcendence of first-generation cognitive science (computational representationalism). Based on Merleau-Ponty's phenomenology of perception, embodied cognition emphasizes "bodily subjectivity." Varela et al. pointed out that cognition is embodied action; the mind is not a mirror reflecting nature but is generated through the body's experiential structure in interaction with the environment [3].

Introducing this theory into red culture education means an ontological regression—returning to the life essence of history. Red history is not a cold archive but a life epic written by countless revolutionary predecessors with flesh and blood through actions in specific spatio-temporal environments. Bleeding, sacrifice, shouting, running—these are extreme bodily experiences. Therefore, understanding red culture is essentially the simulation and reconstruction of these bodily experiences.

Red culture study from the perspective of embodied cognition emphasizes three core dimensions:

Bodily Presence: Learners are present not only in thought but also in body. Through physical movement, posture imitation, and physiological arousal, a physical connection with the historical environment is established.

Multimodal Perception: Breaking visual hegemony, mobilizing a comprehensive sensory system including hearing, touch, smell, and even taste, forming synesthetic experiences and enhancing the depth of information coding.

Situational Interactivity: Cognition emerges in the dynamic coupling of "Body-Environment." The study environment is no longer a static background but an interactive ecosystem constructed through technology, providing real-time feedback on learners' behaviors.

2.3. Embodied Mechanism of Value Internalization: Metaphorical Projection and Emotional Resonance

In Embodied Cognition theory, the understanding of abstract concepts often relies on concrete bodily experiences, a process realized through "Conceptual Metaphor." Lakoff and Johnson argue that the metaphorical system we live by is embodied [4].

In red education, concepts like "Faith," "Sacrifice," and "Unity" are highly abstract moral and political concepts. Without bodily experience as a foundation, these concepts are often hollow. Immersive study empowered by digital intelligence helps learners construct an understanding of abstract values (target domain) precisely by providing simulated bodily experiences (source domain).

For instance, by using VR equipment to simulate the "Seizing of Luding Bridge" scene, when the experiencer feels bodily imbalance on the swaying chains, hears the roar of the rapids below, and feels cold sweat on their palms, this extreme experience of "bodily imbalance/danger" becomes the physiological basis for understanding the abstract concept of "heroic fearlessness." At this moment, value is no longer an instilled dogma but a belief grown from bodily experience. Bodily tremors trigger emotional resonance, which then solidifies into value identification; this is the internal logic from "embodiment" to "internalization."

3. Generative Logic: Techno-Phenomenological Analysis of Immersive Study Empowered by Digital Intelligence

The application of digital intelligence technology in red culture study should not be simply viewed as an upgrade of display methods, but as a technological revolution reconstructing time and space, reshaping senses, and reorganizing cognition. From the perspective of phenomenological technology, digital intelligence technology generates an embodied cognitive immersive field through the following triple logic.

3.1. Spatio-Temporal Reset Logic: From "Physical Segregation" to "Virtual-Real Co-presence"

The primary challenge facing red culture study is the irreversibility of historical time and space. Although traditional physical sites retain spatial attributes, the passage of time has taken away the historical atmosphere of that year. Digital intelligence technology, through Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), breaks the linear constraints of physical time and space, constructing a "virtual-real symbiotic" digital twin space.

Digital Restoration of Historical Scenes: Utilizing technologies like 3D laser scanning and photogrammetry modeling to carry out high-precision digital reconstruction of red sites such as the Guangzhou Peasant Movement Institute and the Site of the Third National Congress of the CPC. This involves not only restoring the architectural entities but also restoring the light and shadow changes, street noise, and even weather conditions of that year through AI algorithms. This high-fidelity digital environment provides a "second nature" for the body to immerse in, eliminating the boundary between reality and history.

Time-Travel Presence Experience: Through Head-Mounted Displays (HMDs), the experiencer's vision and hearing are completely wrapped in digital space, creating a strong sense of "Telepresence." Technology allows the scene to change with the experiencer's perspective through Real-time Rendering, creating the illusion of "I am really there" for the body. This technology-mediated "presence" allows experiencers to travel back a hundred years, placing themselves on the streets of Guangzhou in 1927 and personally experiencing the thrill of the uprising.

3.2. Sensory Extension Logic: From "Single Vision" to "Multidimensional Perception"

McLuhan once said, "Media is the extension of man." [5] As a new type of medium, digital intelligence technology greatly extends the human sensory system, shifting red culture study from single visual browsing to full-sensory embodied interaction.

Simulation of Tactile and Kinesthetic Senses: The application of peripherals like force-feedback gloves, haptic suits, and omnidirectional treadmills allows experiencers to "touch" history. For example, when experiencing an "Anti-Japanese War" scene, the haptic suit can simulate the impact of being shot; when simulating "carrying grain up the mountain," force-feedback equipment can simulate the oppression of heavy weights. This simulation of pain and gravity acts directly on the body's pain nerves and muscular system, creating deep muscle memory.

Stereoscopic Construction of Auditory Landscape: Spatial Audio technology can restore the azimuth and distance of sound sources based on head tracking, creating holographic sound fields such as the roar of the battlefield, whispers in a conference room, or shouts at a rally. Auditory immersion often triggers subconscious emotional fluctuations more effectively than vision.

Synesthetic Effect of Multimodal Fusion: When visual smoke, auditory bugles, and tactile vibrations act on the body simultaneously, the brain's multisensory integration mechanism is activated, forming an overwhelming sense of reality (Verisimilitude). This input of multidimensional sensory data greatly enriches the bandwidth of cognition, making the encoding of red memory more solid.

3.3. Interactive Narrative Logic: From "Passive Acceptance" to "Active Construction"

Traditional study narratives are often linear and closed, output unidirectionally by guides. Immersive study empowered by AI and big data introduces non-linear narratives and generative interaction, endowing experiencers with the identity of "historical participants."

Embodied Role Substitution: The system assigns specific historical roles (such as uprising soldiers, underground party liaisons, progressive students) to each experiencer and assigns corresponding mission objectives. This Role-Playing mechanism forces experiencers to think, act, and choose from the standpoint of that role. In action, experiencers no longer observe the fate of others but experience the role's fate through their own bodies, thereby generating strong empathy effects.

Dynamic Interaction with Intelligent NPCs: Virtual Digital Humans driven by Large Language Models (LLM) can play historical figures and engage in open dialogue with experiencers. Experiencers can discuss the truth of saving the country with a "young Zhou Enlai" or exchange revolutionary ideals with "Chen Yannian." This cross-time-space dialogue is no longer the playback of a preset script but a real-time collision of ideas, greatly stimulating the experiencer's active thinking and value discrimination ability.

4. Practical Path: The Construction System of Immersive Red Culture Study Empowered by Digital Intelligence

Based on the above generative logic and combined with practical explorations in Guangzhou and other places, we propose specific construction paths for immersive red culture study empowered by digital intelligence. This is not just a piling up of technologies but a systematic engineering of content, technology, and educational methods.

4.1. Scene Layer: Constructing an Embodied Field Integrating "Localization" and "Cloud-based"

Red culture study first requires a high-quality embodied field. For a city like Guangzhou with rich red resources, a "virtual-real fusion" construction strategy should be adopted.

Augmented Reality of Physical Sites: We do not advocate purely virtual construction detached from physical sites but

rather using AR technology to "enhance intelligence" for physical sites. For example, at the Guangzhou Uprising Memorial Hall, visitors wearing AR glasses can see superimposed virtual historical event reenactments—red ribbons fluttering, workers' pickets assembling—against the real architectural background. This superposition of "real scene + virtual image" retains the authenticity of cultural relics while activating dormant historical memories, achieving a deep "localized" experience [6].

Cloud-based Digital Twinning of Red Resources: For sites that are damaged or unable to host large-scale visits due to space limitations, construct high-precision cloud digital museums. Utilizing cloud rendering technology, students in classrooms can "walk into" the Site of the Third National Congress of the CPC through VR all-in-one machines, observing the texture of conference tables and chairs in detail, and even picking up documents on the table to read. This "cloud-based" approach expands the coverage and convenience of red culture study.

4.2. Content Layer: Designing Embodied Scripts Focusing on Both "Conflict" and "Empathy"

Technology is the carrier; content is the soul. The core of immersive study lies in script design, which needs to shift from traditional grand narratives to embodied narratives.

Narrative Reconstruction from a Micro-perspective: Grand history often creates a sense of distance, while micro-individual destinies are most touching. Script design should select specific character prototypes and excavate their life details and emotional conflicts. For example, instead of just stating "The Guangzhou Uprising failed," design a script where experiencers play a revolutionary couple holding a "Wedding on the Execution Ground" on the eve of the uprising, experiencing the difficult choice between love and faith at that moment through specific dialogues and exchange of tokens.

Situational Setting of Cognitive Conflict: Piaget believed that cognitive development stems from the breaking of cognitive equilibrium [7]. Scripts should set dilemmas to force experiencers to make value judgments. For instance, when simulating underground work, faced with the conflict between "protecting important intelligence" and "rescuing captured relatives," experiencers must make a decision in a very short time. This embodied choice under high pressure can trigger profound moral reflection, touching the soul more than simple preaching.

4.3. Interaction Layer: Establishing an Embodied Mechanism of "Physical Participation" and "Instant Feedback"

To ensure the effective occurrence of embodied cognition, the design of interaction mechanisms is crucial.

Ritualized Bodily Action: Design symbolic bodily movements during the study process, such as raising a fist during oath-taking, bowing when presenting flowers to martyrs, or running when delivering intelligence. These ritualized actions are not only physical movements but also anchors for psychological suggestion. Correct body posture often drives a solemn mental state, regulating internal attitudes through external behaviors.

Multidimensional Instant Feedback System: Utilize AI technology to analyze and provide real-time feedback on experiencers' behaviors. If experiencers show hesitation or errors in simulated tasks, the system should promptly provide guidance or display the historical consequences of wrong decisions (e.g., mission failure leading to the sacrifice of comrades). This instant negative feedback reinforces the experiencer's sense of responsibility and prudence; positive feedback after task success (e.g., receiving a medal, hearing cheers of victory) enhances their sense of achievement and self-efficacy.

5. Value Transition: The Realization Path from "Physiological Activation" to "Belief Internalization"

Immersive study empowered by digital intelligence ultimately aims to achieve value internalization. This process is not accomplished overnight but follows a progressive logic of "Physiological Activation — Psychological Identification — Spiritual Sublimation."

5.1. Phase I: Sensory Immersion and Physiological Activation

This is the starting point of embodied cognition. Through visual spectacles brought by VR/AR, sound field shock by spatial audio, and physiological stimulation by haptic devices, the experiencer is first awakened at the physiological level. This "sensory wonder" breaks the banality of daily life, focusing the experiencer's attention completely on the current study situation. For example, simulating a battlefield environment with artillery fire causes accelerated heartbeat and adrenaline secretion; this physiological tension lays a biological foundation for subsequent emotional experiences.

5.2. Phase II: Emotional Involvement and Psychological Identification

With the advancement of the plot and deep substitution of roles, physiological arousal transforms into psychological emotional fluctuation. Experiencers generate "Empathy" during interactions with virtual characters. They no longer see revolutionary martyrs as names in textbooks but as flesh-and-blood people with love and hate around them. The grief felt when seeing a "comrade" sacrificed, the joy felt when seeing "victory" arrive—these real emotional experiences melt the historical barrier, making experiencers begin to psychologically identify with the choices and values adhered to by revolutionaries.

5.3. Phase III: Rational Reflection and Belief Internalization

This is the highest stage of value internalization. Pure emotional experience, lacking rational sublimation, easily becomes shallow stimulation. Therefore, immersive study must set up a "Review and Reflection" session. After the experience, through teacher guidance, group discussion, or AI-assisted analysis, guide experiencers to step out of their roles and examine the experience just now: "Why did they persist in fighting in such a desperate environment?" Elevate specific situational experiences to rational thinking about "Original Aspiration," "Mission," and "Faith." At this point, perceptual experience originating from the body and theoretical cognition originating from reason achieve dialectical unity, and red values are finally internalized into

the experiencer's relatively stable psychological structure and belief system [8].

6. Challenges and Reflection: Disenchantment with Technology and the Return of Value Rationality

While fully affirming the value of immersive study empowered by digital intelligence, we must also maintain clear technological rationality and be wary of potential alienation phenomena.

6.1. Guarding against "Technological Fetishism" and Formalism

In practice, some projects tend to "emphasize technology over content." Excessive pursuit of cool audio-visual effects while neglecting the spiritual core of red culture is problematic. If VR experiences become merely "electronic games" of sensory stimulation without profound historical narrative and value guidance, then this "immersion" is false and may even lead to historical nihilism and entertainment [9]. We must adhere to "Content is King"; technology is always a means to serve value transmission, not the end.

6.2. Avoiding "False Homogeneity" and Experience Traps

Current immersive study products suffer from serious homogeneity, often applying one template to all scenarios. There is a lack of excavation of the uniqueness of red culture in specific regions (such as Guangzhou). Embodied cognition emphasizes the specificity of the environment, so we must adapt to local conditions and develop study courses with local characteristics that cannot be replicated. At the same time, prevent "dizziness" or cognitive load overload caused by excessive immersion, scientifically designing experience duration and intensity to ensure the safety and effectiveness of the study.

6.3. Adhering to "Historical Truth" and Ethical Bottom Lines

Digital intelligence technology has strong reconstruction capabilities but also brings the risk of tampering with history. When constructing virtual scenes and scripts, we must strictly adhere to the standpoint of historical materialism and ensure the accuracy of core historical facts. While artistic processing can be done in details, it must not violate historical logic or engage in "vulgar red" or "advanced black." A strict content review mechanism must be established to ensure the correct political direction and value orientation of red culture study [10].

7. Conclusion

The digital intelligence era provides unprecedented opportunities for the inheritance of red culture. The introduction of Embodied Cognition theory reveals the core role of the body in value internalization, while digital intelligence technology provides powerful technological support for this embodied learning. Through the dual drive of "Digital Intelligence Empowerment + Embodied Cognition," we are able to rebuild a passage leading to the depths of history and the heights of faith.

As the source of the modern revolution, Guangzhou's rich red resources are natural fertile ground for carrying out immersive study. By constructing a digital field integrating the virtual and real, designing embodied scripts that touch the heart, and establishing a multi-dimensional interactive participation mechanism, we can make the red gene "come alive" in the bodily experience of teenagers, "warm up" in emotional resonance, and "stand up" in rational identification.

This is not only an innovation in educational technology but also a cultural practice regarding how to place historical memory and how to continue the spiritual bloodline. In future explorations, we need to find the optimal balance point between technology and humanities, virtuality and reality, experience and reason, making digital intelligence technology truly a beam of light illuminating red faith, lighting up the path forward for teenagers in the new era.

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