

From "Digital Collection" to "Educational Scene": The Practical Logic of Red Culture Resource Databases Empowering Research-Based Learning

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Abstract: In the digital age, the protection and inheritance of red culture resources are undergoing a profound paradigm shift. Currently, a vast amount of red cultural resources has been digitized, forming large-scale "digital collections." However, this collection model, centered on data preservation, easily leads to the dilemmas of "data silos" and "disconnection between teaching and application," failing to meet the advanced demands of new-era research-based learning for experiential, interactive, and contextualized engagement. This article aims to explore the internal mechanism of the transformation of red culture resource databases from "digital collections" to "educational scenes." The study posits that this transformation is not a simple technological iteration but a profound transmutation of practical logic. Based on qualitative analysis and theoretical construction, the article proposes that this transformation relies on three interconnected practical logics: First, the reconstruction logic of data, shifting from fragmented data storage to semantic association based on knowledge graphs, laying the data foundation for scene construction. Second, the construction logic of scenes, moving from static digital presentation to immersive interaction based on Extended Reality (XR) and Artificial Intelligence (AI), achieving a sense of "presence" and "personalization." Third, the empowerment logic of research-based learning, transitioning from unidirectional knowledge infusion to deep participation and value creation covering the entire cycle (pre-, mid-, post-learning), ultimately realizing value identification and internalization. The conclusions of this study attempt to provide a theoretical reference for the digitized "activation" and utilization of red cultural resources and offer a feasible path for model innovation in research-based learning under the context of the "Big Ideological and Political Course."

Keywords: Red Culture; Database; Research-Based Learning; Digital Collection; Educational Scene; Practical Logic.

1. Introduction

General Secretary Xi Jinping has emphasized the need to "make good use of red resources, carry forward the red tradition, and inherit the red gene." Against the backdrop of the digital wave sweeping the globe, information technology has become the core driving force for the protection, inheritance, and promotion of red culture. From the 3D modeling of revolutionary sites and digital scanning of revolutionary relics to the database storage of oral histories, the digitization process of red cultural resources has made significant strides, forming voluminous "digital collections."

However, the current practice of digitizing red cultural resources largely remains at the primary stage of "preservation" and "archiving." This resource-centric "digital collection" model, essentially a static, back-end repository, has led to three pressing bottlenecks: First, the "fragmentation" of resource presentation. Red resource databases from different institutions and regions lack uniform standards and operate independently, forming insurmountable "data silos" that prevent users from obtaining a panoramic, interconnected historical understanding. Second, the "homogenization" of presentation methods. A large number of digital achievements are presented on web pages as 2D images, static texts, or simple 3D models, lacking deep interaction and emotional connection, thus becoming "dormant data." Third, the "superficiality" of educational application. In research-based learning practices, these

databases are often used merely as auxiliary data retrieval tools and fail to integrate deeply with teaching design. This leads to a severe "disconnection between teaching and application," and research activities easily degenerate into shallow, "sightseeing" experiences [1].

Meanwhile, new-era research-based learning is shifting from a traditional knowledge-based focus to a competency-based one. It is no longer satisfied with the unidirectional infusion of historical facts but strongly emphasizes learners active inquiry, situational experience, and value internalization. The concept of the "Big Ideological and Political Course" also demands "integrating the small ideological and political classroom with the large social classroom," promoting a scenarized, practical, and collaborative educational model. Clearly, the traditional "digital collection" model can no longer meet the advanced needs of new-era research-based learning.

Therefore, promoting the fundamental transformation of red culture resource databases from "digital collections" to "educational scenes" has become a major issue facing the fields of digital humanities and educational technology. This transformation aims to activate the database from a static "resource warehouse" into a dynamic "learning field"—an educational environment that allows learners to immerse, interact, reflect, and even create.

In view of this, the core research question of this article is: What is the practical logic driving the transformation of red culture resource databases from "digital collections" to

"educational scenes"? How can it break through the limitations of traditional databases to truly empower research-based learning? This article will adopt research methods of theoretical construction and logical deduction, avoiding quantitative analysis, and focusing on analyzing the internal mechanisms and implementation paths of this transformation, aiming to provide a reference for theoretical development and practical innovation in related fields.

2. Conceptual Analysis: The Logical Divergence between "Digital Collection" and "Educational Scene"

Before exploring the logic of transformation, it is essential to first conduct a scholarly analysis of the core connotations of "digital collection" and "educational scene" and the logical divergence behind them.

(A) "Digital Collection": A Resource Logic of Static Preservation

"Digital collection" is the primary form of red culture resource digitization, with its core driving force stemming from "rescue preservation" and "archival management." Its construction logic follows a "resource logic" and has three typical characteristics:

First, the objective: Centered on "authenticity." The primary task of a digital collection is the high-fidelity digital replication and archiving of physical red resources (such as relics, documents, sites). Its value is measured by the completeness, accuracy, and security of the data.

Second, the technical feature: Centered on "storage." Its technical architecture mainly revolves around database management systems (DBMS), supplemented by digitization technologies like scanning, modeling, and cataloging. Data is often organized in relational database structures, emphasizing standardized classification and indexing for easy retrieval and management.

Third, the user role: Aimed at "retrieval." Under this logic, the user is defined as a "browser" or "retriever." The database provides a "what you see is what you get" static interface. The relationship between the user and the resource is a unidirectional "acquisition." This model is like a digital "archive" or "warehouse"; although the resources are "seen," the historical context and emotional warmth behind them are absent.

The limitation of the "digital collection" lies in its "static nature" and "instrumentality." It solves the problem of "whether" red culture resources exist digitally, but it cannot effectively solve the problems of "whether" and "how well" they are used. The "object-based" narrative it provides struggles to evoke emotional resonance in learners, let alone achieve deep value identification.

(B) "Educational Scene": An Educational Logic of Dynamic Generation

"Educational scene" is the advanced form of red culture resource digitization, with its core driving force stemming from "activated utilization" and "value guidance." Its construction logic follows an "educational logic," exhibiting distinct characteristics:

First, the objective: Centered on "experience." The primary task of an educational scene is "education"—that is, to promote learners cognitive construction, emotional stimulation, and value internalization. Its value is measured by the sense of immersion, interactivity, and inspiration of the

learning experience.

Second, the technical feature: Centered on "interaction." It transcends traditional database management, deeply integrating cutting-edge technologies such as Geographic Information Systems (GIS), Virtual/Augmented/Mixed Reality (VR/AR/MR, collectively XR), Artificial Intelligence (AI), and Knowledge Graphs. It constructs not a "repository," but a "field."

Third, the user role: Aimed at "inquiry." Under this logic, the user is defined as a "participant," "explorer," or even "co-creator." The scene is no longer a fixed collection of information but is dynamically generated based on the users inquiry path [2]. It is like an "interactive theater" or a "time-space shuttle," allowing learners to "enter" history, "dialogue" with historical figures (or their digital twins), and complete meaning-making in the process of solving real problems.

(C) The Essence of the Shift: From "Resource-Centric" to "Experience-Centric"

The essence of the transformation from "digital collection" to "educational scene" is a shift in design philosophy from "resource-centric" to "experience-centric."

A "digital collection" answers the question, "What resources are here?"—a supply-side logic. An "educational scene" answers, "What will the learner experience here?"—a demand-side logic. The former focuses on the digitization of "things," while the latter focuses on the digital experience of "people."

This shift means that database designers must transition from the role of "archivists" to "educational designers" and "narrative directors." The database is no longer a tool passively awaiting calls but an organic component that actively participates in, reshapes, and empowers the teaching process. This profound paradigm shift must be built upon interlocking practical logics.

3. Practical Logic 1: The Reconstruction Logic of Data—From "Silos" to "Graph"

The construction of an "educational scene" is not built in the air; it must rely on the solid support of underlying data. If the data in a "digital collection" is fragmented and isolated, the construction of upper-layer scenes is impossible. Therefore, the first logic of transformation is to achieve the reconstruction of data, moving from "data silos" to "knowledge graphs."

(A) The Practical Dilemma: Data Fragmentation and the Semantic Gap

Red cultural resources are inherently complex, spanning time, space, media, and subjects. A revolutionary document, a battle site, an oral history, a revolutionary relic—they all have intricate internal connections. However, in the "digital collection" stage, the management authority for these resources is dispersed among archives, museums, memorial halls, and party history research offices, leading to severe "data silos."

A deeper problem is the "semantic gap." Traditional databases rely on keyword matching for surface-level retrieval. They can tell a user in which documents the word "Ye Ting" appears, but they cannot "understand" the complex relationship between Ye Ting, the "Ye Ting Independent Regiment," the "Northern Expedition," and the "Yuejiang Tower in Zhaoqing." Data lacks a semantic "adhesive," leading to a dilemma of "much data, little knowledge; much

information, little wisdom." Such fragmented data can only support fragmented cognition, not the "panoramic" historical inquiry required by research-based learning.

(B) The Reconstruction Path: Standardization, Association, and Knowledge-lization

To break down silos and bridge the gap, data reconstruction must follow the progressive path of "standardization—association—knowledge-lization."

First, standardization is the basic prerequisite. A unified, extensible metadata standard for red cultural resources must be established. This standard should not be limited to traditional archival cataloging (like title, author, date) but must be oriented towards the needs of "educational scenes," adding semantic fields that describe historical context, such as "associated figures," "associated events," "geographic coordinates," "educationally applicable grade level," and "emotional tags."

Second, association is the core method. Based on standardized data, Semantic Web technologies are needed to transform data from "isolated records" into "interlinked nodes." This requires an evolution from traditional relational databases (SQL) to graph databases.

(C) The Transformation Goal: Constructing a Red Culture Knowledge Graph

The final form of the data reconstruction logic is the construction of a dynamic, open "Red Culture Knowledge Graph" [3].

A knowledge graph is a semantic network that stores knowledge in a graph structure. In the Red Culture Knowledge Graph, every "entity" (e.g., person, event, location, relic) is a node, and the "relations" between entities (e.g., "participated in," "occurred at," "commanded") form the "edges." For example, the graph can clearly reveal the complete knowledge chain: [Yuejiang Tower in Zhaoqing]—(Stationed)—[Ye Ting Independent Regiment]—(Participated in)—[Northern Expedition]—(Related Figure)—[Ye Ting]—(Oral History)—[A Certain Veteran].

The construction of the knowledge graph completely changes the data logic of the "digital collection":

1. From "Data Retrieval" to "Knowledge Navigation": Users no longer "search" for data but "navigate" the knowledge graph. They can follow any entity node to explore all its associated dimensions, achieving a panoramic, systematic historical understanding.
2. From "Data Silos" to "Knowledge Fusion": The knowledge graph can effectively fuse heterogeneous data from different sources (e.g., documents, images, audio, 3D models), stitching fragmented "data points" into a complete "knowledge web."
3. From "Static Storage" to "Intelligent Reasoning": The knowledge graph possesses certain reasoning capabilities, able to discover hidden, deep connections between data, providing intelligent data support for the upper-level "educational scene" [4].

In short, the data reconstruction logic is the "foundation" for the transformation. Without semantic, structured data based on a knowledge graph as the "raw material," any immersive "educational scene" will be water without a source, a tree without roots.

4. Practical Logic 2: The Construction Logic of Scenes—From "Presentation" to "Immersion"

On the solid foundation of the knowledge graph, the second logic of transformation—the construction logic of scenes—can unfold. The core of this logic is to elevate the display of red cultural resources from static "digital presentation" to dynamic, interactive "immersive scenes."

(A) Beyond "Digital Presentation": The Flattened Narrative of Traditional Collections

The typical application of a "digital collection" is a "digital exhibition" or "online museum." The mainstream form of this model is "tiling" resources on a webpage, such as scrolling images, clickable texts, and 360-degree rotating models of relics.

This "presentation" model is inherently "flat." It "compresses" three-dimensional, vivid, and emotional history into two-dimensional information. The learner, as an "onlooker," is separated from historical events by the natural barrier of a "digital screen." This sense of "detachment" and "dispresence" is a significant reason why red culture education "enters the eyes but not the heart."

(B) Scene Creation: Spatio-Temporal Restoration and Multi-dimensional Narrative

The construction of an "educational scene" must first solve the problem of "presence." It requires using technology to transform the learner from an "onlooker" to an "experiencer," breaking time-space barriers to create a "here and now" historical context.

First, Spatio-Temporal Restoration. This is the physical basis for scene construction. Using GIS technology, a "Red Culture Digital Map" can be built, plotting the events, sites, and figures from the knowledge graph into real geographic space, overlaying historical information onto geography. Based on this, VR (Virtual Reality) technology can be used for high-fidelity 3D restoration of historical sites that have disappeared or are difficult to access (like battle command posts, secret contact points). By wearing a VR headset, learners can "teleport" back to the historical site, achieving physical "presence."

Second, Multi-dimensional Narrative. Spatial restoration alone is insufficient; the scene must "tell a story." A "digital collection" provides an "archival narrative," whereas an "educational scene" must provide a "dramatic narrative" [5]. This requires the database designer to transform into a "digital curator," using the data associations in the knowledge graph to design multiple narrative threads. For example, in a "Northern Expedition" scene, learners could choose the commanders perspective of "Ye Ting" or the individual perspective of a "common soldier." Different perspectives would trigger different event chains and archival materials, allowing for a three-dimensional, multi-faceted understanding of the same historical event.

(C) Interactive Empowerment: From "Passive Watching" to "Active Exploration"

The highest form of immersion is interaction. If spatio-temporal restoration solves "presence," then interaction solves "engagement." The construction logic of an "educational scene" requires using technology to break the "fourth wall," making the scene no longer preset and closed, but responsive and generative.

First, "Physical-Virtual Fusion" interaction based on XR technology. In research-based learning, AR (Augmented

Reality) technology plays a key role. When students physically visit a site (like the Yuejiang Tower in Zhaoqing), the knowledge graph in the database is activated via the camera of a mobile device (like a tablet). AR technology can overlay virtual historical information (e.g., a virtual image of the Ye Ting Independent Regiment taking their oath, the style of the military flag at the time) onto the real physical environment, achieving "physical-virtual fusion." Students are no longer "listening to an explanation" but "watching history happen," seamlessly bridging the physical and digital scenes.

Second, "Personalized Generation" interaction based on AI technology. Artificial Intelligence, especially Generative AI (AIGC), is the fundamental marker distinguishing an "educational scene" from a "digital collection" [6].

1. Intelligent Guidance and Q&A: The scene can feature AI-based "virtual historical figures" (like a virtual guide or a virtual Regiment Commander Ye Ting). Driven by large language models, they can understand learners natural language questions and call upon data from the knowledge graph to conduct in-depth, emotional "human-computer dialogues."
2. Personalized Content Generation: The scene system can dynamically and instantly generate (AIGC) personalized learning content based on the learners cognitive level, interest tags, and inquiry path. For example, for primary school students with a weak historical foundation, the system automatically generates an easy-to-understand "storyline"; for high school students with research capabilities, it automatically pushes relevant "archival documents" and "in-depth inquiry tasks."

At this point, the scene construction logic is complete: it uses the knowledge graph as the "script library," XR technology as the "stage," and AI technology as the "director" and "fellow actor." The database is thoroughly transformed from a "static presentation system" into a "dynamic, personalized, and interactive immersive experience system."

5. Practical Logic 3: The Empowerment Logic of Research-Based Learning—From "Knowledge Infusion" to "Value Identification"

Data reconstruction is the foundation, scene construction is the means, and empowering research-based learning is the ultimate goal. The third logic of transformation lies in how the "educational scene" deeply couples with the entire process of research-based learning, cracking the traditional problems of "superficial understanding" and "separation of knowledge and action," and achieving the educational leap from "knowledge infusion" to "value identification" [7].

The empowerment of research-based learning by the "educational scene" database is reflected in the systematic reshaping of the three stages: pre-research, mid-research, and post-research.

(A) Pre-Research: Situational Previewing and the Generation of Authentic Questions

The preparation phase for traditional research-based learning (including red culture learning) often involves simply reading background materials about the destination, with students in a passive receiving mode.

The "educational scene" database transforms the pre-research preparation into a "Situational Previewing." Students

can use the databases VR function to "pre-visit" the destination and use the knowledge graph to sort out the historical context. This highly immersive preview easily stimulates students "cognitive conflict" and "authentic curiosity." For example, if a student discovers in a VR scene that the layout of a site does not match historical records, they will naturally generate authentic questions like, "Why is it like this?" or "What happened back then?"

The empowerment logic at this stage is "question-driven." The database is no longer a provider of answers but an "igniter" of questions. When students enter the physical research phase with "authentic questions," their learning initiative and inquiry depth are thoroughly activated.

(B) Mid-Research: Physical-Virtual Fusion and On-Site Meaning-Making

The core pain point during the research phase is the separation of "scenery" (the physical site) and "sentiment" (the historical emotion). Students are physically present at the site (scenery) but find it difficult to empathize with the revolutionary passion (sentiment) of a century ago.

The "educational scene" database, through its "physical-virtual fusion" interactive logic, becomes the bridge connecting "scenery" and "sentiment." As mentioned earlier, during the physical research, students use AR technology to "awaken" dormant history. When AR overlays the virtual scene of the "Ye Ting Independent Regiments Oath" onto the real space of the Yuejiang Tower, the strong spatio-temporal contrast (scenery) brings about a huge emotional impact (sentiment), allowing on-site meaning to be constructed [8].

Simultaneously, the database can push "digital research task packs" to learning groups based on their location (LBS). For example, the system might require students to find clues at Site A corresponding to a key figure in the knowledge graph and use oral history data from the database to perform a "scenario enactment." The empowerment logic at this stage is "on-site interaction." The database gamifies and task-ifies the research process, guiding students to complete deep historical experiences and immediate reflections through constant switching between the "virtual" and the "real."

(C) Post-Research: Outcome Creation and Deep Value Internalization

The outcomes of traditional research-based learning are often cookie-cutter "research reports," which devolve into formalism. The crucial post-research reflection and sublimation phase is often missing.

The "educational scene" database provides a platform and tools for "value creation" from the research outcomes. After the research, students are no longer simply repeating knowledge; they are required to "re-create" using the rich materials provided by the database (high-precision models, archival texts, oral history audio, historical images).

For example, students can use materials from the database, combined with their own research insights, to produce a "red culture micro-video," curate an "online virtual exhibition," or design a new "AR script" and upload it back to the database for future students to experience.

The empowerment logic at this stage is "value internalization through creation" [9]. In the process of "retelling" history, students must reorganize, filter, and refine fragmented knowledge, injecting their own understanding and emotions. This high-order cognitive activity of "encoding-decoding-re-encoding" is the only way to achieve value identification and internalization [10]. The database, at this point, transforms from a "learning platform" to a

"creation platform." Students also transform from "experiencers of the scene" to "co-constructors of the scene," achieving the highest goal of research-based learning.

6. Conclusion: A Paradigm Shift from "Tool" to "Field"

The digital wave of red cultural resources is driving profound changes in educational forms. This study indicates that if red culture resource databases are to truly empower new-era research-based learning, they must transcend the "digital collection" paradigm centered on "preservation."

This transformation is not an isolated technological upgrade but a "practical logic" reconstruction with interlocking links. It begins with the "foundational logic" of transformation—the reconstruction of data—by integrating "data silos" into a "Red Culture Knowledge Graph" through standardization and association, providing semantic data support for upper-level applications. Subsequently, it relies on the "methodological logic" of transformation—the construction of scenes—by upgrading "static presentation" to "immersive interaction" using XR and AI, achieving "presence" and "personalization." Finally, it serves the "objective logic" of transformation—the empowerment of research-based learning—by reshaping the entire pre-, mid-, and post-research cycle, guiding learners from "knowledge infusion" to "problem inquiry" and "value creation," ultimately achieving value internalization.

These three logics are progressive and indispensable, jointly driving the transformation of red culture resource databases from a "resource-centric" "digital warehouse" to an "experience-centric" "educational field."

The significance of this paradigm shift is not only technological but, more importantly, educational. It signals that the red culture database is no longer just an auxiliary "tool" for ideological and political education but has become an important "field" for the "Big Ideological and Political Course" itself. It is no longer just a "container" of historical knowledge but a "crucible" for inheriting the red gene. This transformation path provides an operational theoretical framework and practical direction for how to "activate" red resources, tell China's story well, and empower the fundamental task of fostering virtue through education in the

digital age.

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