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Research on International Digital Humanities Infrastructure Development for the Visual Arts

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Abstract

Purpose/Significance From a disciplinary perspective, this article investigates digital humanities institutions abroad that conduct visual arts research and their project outcomes, aiming to provide references and insights for the development of digital humanities infrastructure in China's visual arts field. **Method/Process** Using web survey and case analysis methods, with centerNet as the data source, this article reviews typical cases of digital humanities centers abroad that conduct visual arts-related research, along with their databases, research tools, and cyberspace. **Results/Conclusion** The development of digital humanities infrastructure in China's visual arts field should focus on four aspects: establishing demand-oriented visual arts digital humanities centers, strengthening the in-depth development of existing art-featured databases, conducting digital humanities education and training, and establishing a coordinated co-construction mechanism for visual arts digital humanities achievements.

Full Text

Research on Foreign Digital Humanities Infrastructure Construction for Visual Arts: A centerNet Perspective

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Abstract: [Purpose/Significance] From a disciplinary perspective, this article surveys foreign digital humanities institutions and their project outcomes in visual arts research, aiming to provide references for constructing digital humanities infrastructure in China's visual arts field. [Method/Process] Using web survey and case analysis methods, with centerNet as the data source, this article reviews typical cases of foreign digital humanities centers engaged in visual arts research, including their databases, research tools, and cyberspace initiatives. [Results/Conclusion] The construction of digital humanities infrastructure for

visual arts in China should focus on four key aspects: establishing demand-oriented visual arts digital humanities centers, strengthening in-depth development of existing art characteristic databases, developing digital humanities education and training programs, and establishing a coordinated co-construction mechanism for visual arts digital humanities achievements.

Keywords: Visual Arts; Digital Humanities; Infrastructure Construction

Classification Number: G250

1.1 Background

In recent years, academia has gradually formed an interdisciplinary research field characterized by the deep integration of digital information technology and humanities—digital humanities. Humanities scholars have shifted their research medium from traditional printed texts to hypertext, their research tools from individual document discovery and personal inspiration to software tools, and their research methods have evolved to include new forms of computational data analysis, retrieval, and visualization. Through collaboration with data experts and computer scientists, humanities scholars have applied digital technology throughout the entire research process. These new perspectives and methods have yielded numerous remarkable research achievements and confirmed the paradigm shift in humanities research. This transformation of scientific research paradigms relies on new research infrastructure to provide rich data and strong technical support. As digital humanities practices deepen, the demand for research infrastructure among humanities scholars has become increasingly urgent. Currently, major research institutions and universities worldwide have established digital humanities centers to carry out infrastructure construction and humanities research around knowledge production, representation, utilization, dissemination, and exchange. The report of the 20th Party Congress also made important arrangements for prospering China’s cultural undertakings and industries, proposing the “implementation of a national cultural digitalization strategy,” which points the way for the construction and application of cultural big data in China.

The rise of digital humanities has profoundly impacted knowledge production, representation, and dissemination in fields such as linguistics, literature, sociology, history, and art studies. Ke Ping et al. [1] found through keyword quantity and frequency statistics of digital humanities research topics in Web of Science that art studies constitute one of the important application fields of digital humanities. Digital art has become an emerging research topic, with researchers focusing on using digital technology for quantitative analysis of art history and clustering and visual expression of image features in artworks. Regarding visual arts, in the narrow sense, they include paintings, sculptures, design, architecture, crafts, and other artworks appreciated through visual perception [2]. At the institutional level serving visual arts research, major art academy libraries in China have established art characteristic databases based on their collections or specific themes, such as the Wu Guanzhong Art Database

at Tsinghua University Academy of Arts & Design, the Shadow Puppet Digital Museum at China Academy of Art Library, the Lingnan Art-related Special Collection at Guangzhou Academy of Fine Arts Library, the Special Collection Archives Database at Luxun Academy of Fine Arts Library, and the Southwest Art Digital Information Platform at Sichuan Fine Arts Institute. These have achieved digitization of resources on specific topics within certain scopes and can be considered part of visual arts digital humanities infrastructure to some extent. However, these database systems only implement basic functions such as keyword retrieval and categorized display of digital resources, lacking data visualization, content feature clustering, and image semantic annotation, thus failing to effectively serve visual arts researchers' needs for retrieving image content and themes.

At the researcher level, some scholars have explored image data infrastructure construction. Yang Min et al. [3] investigated the commonalities, characteristics, advantages, and disadvantages of influential image database construction domestically and internationally from the perspectives of content description, database construction technology, services, and copyright. Yan Jia et al. [4] systematically reviewed image data infrastructure construction in China's library, museum, and archive fields, discovering through author collaboration mapping that Wuhan University's Digital Humanities Center is the largest collaborative team in China. The Wuhan University Digital Humanities Center has built a multimodal knowledge base for Dunhuang Mogao Grottoes using linked data and knowledge graph technology, and conducted visualization and semantic publishing application experiments [5]. Specifically in the visual arts field, humanities scholar Xiang Fan [6] independently developed the online large-scale image visualization tool AwardPuzzle, enabling the public to freely explore the intrinsic connections among 2,276 award-winning oil paintings from macro to micro perspectives. Wang Ping [7] used text mining and topic clustering techniques, combined with the "keyword" analysis method of intellectual history, to analyze the prototypes and evolution of images and semantics in Five Dynasties and Song Dynasty landscape paintings on themes of "cold forest," "snow scenery," and "fisherman's reclusion," finding that the formation and rise of landscape painting were essentially influenced by the development and evolution of Confucian "cosmology" and "self-cultivation methods." In summary, although China's visual arts field has a certain foundation in digital humanities practice, the overall level of resource organization and development based on digital technology is relatively low, failing to meet the urgent needs of current visual arts researchers for research resources and tools. Based on this, this article attempts to survey foreign digital humanities institutions and their project achievements in visual arts research from a disciplinary perspective, hoping to provide references for constructing digital humanities infrastructure in China's visual arts field.

1.2 Digital Humanities Infrastructure

Regarding the connotation and extension of digital humanities infrastructure, the most frequently cited work in Chinese academia is the article “National Data Infrastructure for Humanities Research” [8]. The authors define digital humanities infrastructure from a broad perspective as the basic conditions necessary for conducting humanities research in a digital environment, including all literature, data, relevant software tools, public facilities for academic exchange and publication, and related services worldwide related to research topics. Specifically, digital humanities infrastructure includes three levels: institutional organization, database platforms and research tools, and academic exchange and publishing platforms. From a narrow perspective, digital humanities infrastructure includes digital literature resources, databases, tool platforms, and cyberspace supporting knowledge production and information exchange [9].

2 Data Sources and Research Methods

This article uses the international digital humanities center website centerNet as its data source. CenterNet [10] is a virtual network of digital humanities centers worldwide, jointly initiated by the U.S. National Endowment for the Humanities and the University of Maryland in 2007. It collects many excellent digital humanities projects from abroad and aims to promote research practice in digital humanities and related fields through mutual collaboration. This study’s survey data primarily comes from the websites of various digital humanities centers on the centerNet site, with the survey period being May to November 2022. As of November 2022, centerNet had 203 registered member institutions, with nearly 90% of digital humanities centers concentrated in Europe and America, and only five in China (Wuhan University Digital Humanities Research Center, Beijing Key Laboratory of Mobile Media and Cultural Computing, Hong Kong Baptist University Library, Taiwan Dharma Drum Institute of Liberal Arts Library and Information Center, and Taiwan Digital Humanities Research Center).

This article employs web survey and case analysis as its primary research methods. We sequentially visited and browsed the homepages of 198 foreign digital humanities centers, collecting and organizing information related to digital humanities practice and research in the visual arts field, such as center introductions, organizational affiliations, team composition, and digital humanities practice projects. Excluding inaccessible webpages, a total of 16 digital humanities centers were found to conduct visual arts-related digital humanities practice and research, as shown in Table 1 .

3.1.1 Organizational Affiliation

As seen from the introductions of digital humanities centers in Table 1, visual arts digital humanities research and practice all rely on universities. Universities’ rich literature resources and multidisciplinary researchers provide resource guarantees and talent support for digital humanities research. Regarding orga-

nizational affiliation, half of the digital humanities centers are affiliated with university faculties, mostly humanities faculties, such as the Australian National University's CDHR, Utrecht University's DHLab, University of Alberta's CIRCA, University of Canterbury's UC Arts, University of Bologna's DH.ARC, Cambridge University's CRASSH, and The Open University's DH_{OU}, all affiliated with humanities and arts faculties. Only the University of London's CIRCAh research group is under the University of London's Department of Information Studies, leaning toward information science. These types of digital humanities centers mostly serve faculty and students in conducting broader research and teaching. The other half are independent research institutions within universities or cross-university digital humanities organizations (such as the European Association for Digital Humanities, EADH) that conduct digital humanities practice and research by forming interdisciplinary research teams or collaborating with other institutions.

3.1.2 Research Team Composition

Digital humanities centers feature interdisciplinary or cross-institutional characteristics, with research teams composed of scholars from different disciplinary backgrounds, primarily humanities such as anthropology, art studies, linguistics, and history, as well as IT professionals from computer science. For example, Utrecht University's DHLab consists of eight technical developers who primarily provide IT support for humanities research [27]. Since digital humanities centers are all university-affiliated, their team members are mostly university researchers, professors, postdoctoral fellows, graduate students, and visiting scholars. On the other hand, independent digital humanities centers collaborate not only with various faculties within their universities but also with external institutions such as museums, libraries, archives, and other cultural and educational organizations on projects to address urgent issues they face. Therefore, collaborative partners can also be considered part of the research team composition.

Digital humanities center teams have different organizational structures depending on their research fields and collaboration methods. Some centers have relatively small teams with flexible structures, while others have formed clear division-of-labor organizational frameworks. For example, Cambridge University's CRASSH team includes a Digital Humanities Director, Principal Investigators, Visiting Fellows, Professional Research Associates, Academic Coordinators, Guest Researchers, Learning and Events Coordinators, Computing Officers, Web Project Managers, Postdoctoral Researchers, Senior Research Associates, Research Project Administrators, Research Quality Assistants, Digital Humanities Communications and Liaison Coordinators, and Accountants [28]. UCL's UCLDH consists of a management team, staff teams from across the college, an industry advisory group, and visiting scholar teams [29]. The Digital Humanities Center for Japanese Arts and Cultures includes five research groups: Cultural Studies Group, Japanese Cultural Studies Group, Historical

Geographic Information Research Group, Digital Archives Technology Research Group, and Network Technology Utilization Research Group [30].

3.2 Database Platforms and Research Tools

Based on publicly available information from the aforementioned digital humanities center websites, nine digital humanities centers have developed 28 projects related to visual arts databases, research tools, and cyberspace construction. The other seven centers focus on digital technology-based visual arts research and digital humanities education and services. This article selects representative cases of data platforms and research tools from dimensions including research content, knowledge organization methods, platform functions, digital technology and methodology applications, and information comprehensiveness.

3.2.1 Database Construction Based on Digital Technology

The foundation of digital humanities research is structured and richly annotated corpora, as high-level knowledge can only be generated with sufficient accessible rich data [1]. Therefore, building corresponding databases using digital technology is a crucial component of digital humanities infrastructure construction and the core of conducting digital humanities research. Researchers Suárez and Rosa from the University of Western Ontario's CulturePlex Laboratory [31] argue that creating metadata and datasets for digital objects of artworks according to linked open data principles, as well as building relational databases based on schemas and real-world models, not only enriches image content analysis but also constructs a new form of art history writing. Currently, foreign visual arts databases primarily use digital technologies such as Geographic Information Systems (GIS), linked open data, semantic web, and knowledge graphs to deeply reveal and connect art images and textual documents, conveying abstract concepts through visualization to achieve organization and reconstruction of art knowledge contexts and content.

(1) Utrecht University Digital Humanities Lab

The ARTECHNE project [32] of Utrecht University's Digital Humanities Lab digitizes existing art manuscripts and artist handbooks from 1500-1900 and establishes a corresponding database. This database uses GIS technology to build an online historical semantic map of "techniques" in art and recreates history through experiments, ultimately opening the black box of technique transmission in visual and decorative arts. All literature resources in the database are geo-tagged, allowing search results to be visually displayed according to geographic location and historical transmission paths based on user-input keywords. The database also uses linked open data to collect information sources about artists and related literature.

(2) University of Virginia Institute for Advanced Technology in the Humanities

The University of Virginia's Institute for Advanced Technology in the Humani-

ties has built three databases based on specific painting themes and individual artist cases, exploring the relationship between text and image, comparative analysis between texts, and crowdsourcing user participation in resource construction.

Life of the Buddha (LOTB) [33]: The LOTB project is based on the famous murals depicting the life of Buddha in Tibet’s Jonang Pencolin Monastery, and includes three types of textual resources: the literary narrative work “Sun of Faith” on Buddha’s life stories, painting manuals (guiding how to visually depict literary narratives), and inscriptions on mural surfaces. A key feature of this project is the visualization research on the relationship between text and image. LOTB uses open-source technologies and tools compliant with the International Image Interoperability Framework (IIIF) to create a comprehensive system integrating search, navigation, viewing, and image annotation functions, connecting textual resources to specific image regions in a structured manner so that multiple resources display in organized hierarchies. The system enables comparative analysis of visual narratives (Jonang murals), textual narratives (Sun of Faith), and visual narrative construction guides (painting manuals), visualizes relationships between text and image, and allows keyword searches to identify visual elements at macro and micro scales (individual figures, locations, narrative vignettes) to understand narrative and thematic relationships between elements.

Leonardo da Vinci and his Treatise on Painting [34]: This project comprehensively collects and organizes for the first time the original manuscripts, manuscript copies, printed editions, and related visual and oral materials of Leonardo da Vinci’s representative art theory work “Treatise on Painting.” It adopts a new interpretive methodology combining traditional scholarship in art history, linguistics, literature, and cultural history with new IT-based research tools to analyze previously undiscovered or neglected content in da Vinci painting theory research, particularly textual and visual variations, relationships between text and image, their physical characteristics, and the synchronic and diachronic transmission paths of the Treatise across different times and places. The database’s comparative analysis tools can compare textual and illustrative changes and continuities across different manuscript and printed versions, and enable further in-depth analysis of single textual units and illustrations to reveal the exact nature of variations, continuities, and variants among all manuscripts and printed versions contained in the digital archive.

The Complete Works and Pictures of Dante Gabriel Rossetti [35]: Rossetti was the most distinctive painter among the Pre-Raphaelites. This database collects all of Rossetti’s manuscripts, proofs, and original version paintings and design works, along with related commentaries and annotated textual materials. By encoding all materials to form a corpus and developing a new search engine based on open-source Lucene, it provides multiple search types (title search, Boolean search, phrase search, type search, name search, and date search) and structured analysis. The database also allows users to bookmark

and annotate any digital objects in the archive and share their collections, displaying peer-reviewed texts and images in specific online exhibitions.

(3) University of Bologna Digital Humanities Advanced Research Centre

The University of Bologna's Digital Humanities Advanced Research Centre's practice in visual arts primarily uses technologies such as ontology, linked open data, semantic web, and knowledge graphs to reveal and query relationships between art documents.

Italian Cultural Heritage Knowledge Graph (ArCo) [36]: Based on the cultural heritage description standards of Italy's Ministry of Cultural Heritage (MiBAC) agency ICCD, ArCo designs an ontology network and knowledge graph of 800,000 Italian cultural entities, revealing relationships among artists, locations, institutions, etc.

ARTchives - Archive Catalog of Art Historians [37]: ARTchives collects and organizes archival information on world-renowned art historians, as well as artists' works, viewpoints, primary information sources, and creative methods. Using semantic web technology, it creates a knowledge graph of art historian archives based on historical research and provides accurate linked open data, offering users new ways to discover data and enabling them to identify and retrieve the full picture of archives relevant to their research.

MythLOD [38]: This project uses semantic web technology to display 4,260 artworks with mythological themes in linked open data format, focusing on formalizing expert analysis when artworks (and their interpretations) are associated with textual sources. Additionally, the project uses hierarchical knowledge organization methods to simultaneously display artwork descriptive metadata and corresponding contextual interpretation information.

ZERI & LODE [39]: The ZERI & LODE project uses two metadata content standards issued by Italy's Ministry of Cultural Heritage to catalog art historical photograph archive data: Scheda F for Scheda di fotografia (photographs) and Scheda OA for Scheda Opera d'Arte (artworks), building the Zeri photograph archive catalog. The project constructs the CIDOC Conceptual Reference Model, using multiple ontologies representing art and photography fields (such as OAEntry ontology, FEntry ontology, and HiCO ontology) to demonstrate the richness of Zeri's art historical photographs. Through approximately 11 million RDF statements, it accurately describes 19,000 artworks and over 30,000 photographs depicting such works, and creates linked open data based on the developed model to expand semantic expression in visual arts.

3.2.2 New Software Tool Development

According to Manovich's insight, software is not only a prerequisite for generating today's texts (including images) but also a tool for users to receive and utilize texts, and the most important and direct tool for user-text interaction

[40]. In visual arts, artwork images are one of the primary information carriers, playing a crucial role and having a profound impact on art knowledge production, dissemination, and art history research. Based on specific research needs in visual arts, digital humanities scholars have fully utilized digital technology to develop corresponding search tools to facilitate users' search and study of artworks.

(1) Open Art Images Visual Search Engine

A project team from the European Association for Digital Humanities developed the “Open Art Images” [41] visual search engine, which can search high-resolution images of artworks in the public domain or with usage licenses from around the world. Users can input keywords to obtain matching image lists, view detailed information about all images (such as title, artist, date, medium, technique, source and link, current location, credit, and license), and download original image files. In addition to self-searching through the search box, users can also browse according to hot search terms, artist directories, and common theme words provided on the homepage. The project team hopes to promote sharing of art resources and make art and cultural heritage accessible to anyone anywhere in the world.

(2) Replica Visual Attribute Search Engine

The “Replica” [42] project led by the Digital Humanities Laboratory at EPFL (Swiss Federal Institute of Technology Lausanne) uses deep learning and convolutional neural network technology to establish the first search engine for artworks (including paintings, drawings, engravings, sculptures, and photography) searchable by visual attributes such as shape, pattern, and color. This visual similarity-based discovery model represents a major breakthrough from current artwork databases that can only search through keywords or tags (i.e., textual metadata search), providing art historians with entirely new perspectives for studying art images, forms, styles, and transmission patterns.

(3) Web Crawler mAuth

Researchers at the University of Bologna's Digital Humanities Advanced Research Centre used digital technology to develop a semantic-based web crawler called mAuth [43]. mAuth can collect attribution information for 15th-16th century artwork authors from web databases, such as art historians' commentaries and viewpoints on the author, bibliographic information related to the author, and artwork images, returning search results ranked by authority. This program helps art historians improve work efficiency when understanding the authority of art historical literature and, to some extent, changes the research scenarios and paradigms of art history.

3.3 Academic Exchange and Publishing Platform

The collaborative nature of digital humanities practice combined with network communication technology has given rise to entirely new knowledge production mechanisms. Digital humanities communities are large-scale and diverse

in nature, craving and increasingly enjoying interactive and friendly academic discussions. In such interactions, layered academic critiques appear in the form of “version updates,” creating an interactive feedback loop among thinking, creation, and practice [44]. By building new academic exchange platforms, using crowdsourcing technology and online games to explore art dissemination pathways, and conducting empirical research on the “open content movement” for artworks, digital humanities scholars have pioneered new models of collaborative research and knowledge dissemination in visual arts.

3.3.1 Academic Social Networking Site HASTAC.org

The “Humanities, Arts, Science, and Technology Alliance and Collaboratory” at Duke University collaborated with a Stanford University research team to develop HASTAC.org [45], a participatory, open, and free academic social networking site. The website features six themes: teaching practices; humanities, arts, and media; technology, networks, and science; social and political issues; educational and cultural institutions; and publishing and archives. Each theme includes related blogs, member information, groups, organizations, collections, and news. Currently, HASTAC.org has about 14,000 members, including humanists, artists, social scientists, scientists, and technology experts, who can freely communicate with each other and create online discussion groups according to research topics.

3.3.2 USEUM Online Art Museum

A PhD dissertation project from UCL’s Centre for Digital Humanities developed the USEUM online art museum [46], providing an online communication space for artists and art enthusiasts to engage in dialogue. Platform users can appreciate 82,000 artworks by 10,000 artists from the Renaissance to the present in various ways, such as rating artworks, curating, documenting, and uploading works to USEUM’s online exhibitions. The USEUM project explores the advantages and challenges of using crowdsourcing and gamification in fine arts, deeply understanding how copyright and licensing trends (such as the open content movement) positively impact art accessibility, and demonstrates the feasibility of using crowdsourcing and gamification on online platforms to increase user access to artworks [47].

3.3.3 Open Arts Journal

The *Open Arts Journal* [48] founded by the UK’s Open University is a rigorously edited and peer-reviewed platform for practitioners in art, architecture, and design, as well as historians, curators, and researchers in the art field. It conducts truly meaningful online open-access academic activities through content and dissemination medium innovation. The journal publishes at most twice a year, with each issue focusing on a key theme coordinated by a guest editor and, in consultation with an international editorial board, conducting thorough

and in-depth peer review of theme proposals, providing a platform for artists to showcase their creative works. Contributors include artists, curators, and art historians who publish original art criticism or debates on relevant themes and share rigorous art history theoretical research. The journal's content can be accessed through search engines and found in major libraries worldwide and some academic associations. Each work or article has a permanent Digital Object Identifier (DOI) and is protected by Creative Commons licenses.

4 Implications and Reflections

The above analysis shows that in terms of institutions and personnel, foreign visual arts-oriented digital humanities practice mainly relies on university humanities faculties and researchers from different professional backgrounds. In visual arts resource organization, they fully utilize digital technologies such as GIS, linked open data, semantic web, knowledge graphs, and ontology models for unified expression of visual arts knowledge, deeply revealing specific-theme textual literature and artwork images in linked data form, and displaying research topic knowledge contexts through visualization, facilitating sharing and reuse of visual arts resources. In visual arts resource development and utilization, they explore new paths for online academic exchange, collaboration, and knowledge dissemination through crowdsourcing technology and open access. Researchers from different disciplinary backgrounds jointly participate, using digital humanities centers as bases, digital technology as support, and project research as the form, collectively building the cornerstone of visual arts digital humanities infrastructure. Based on the above review and combined with the current state of digital humanities research in China, we offer the following reflections on constructing digital humanities infrastructure for China's visual arts field.

4.1 Establishing Demand-Oriented Visual Arts Digital Humanities Centers

At the national level, the proposal of “new liberal arts” promotes the upgrading of traditional liberal arts, shifting from discipline-oriented to demand-oriented, from professional segmentation to cross-disciplinary integration, and from adaptive service to supportive leadership [49]. From this perspective, the deep integration of digital technology and visual arts disciplines will become a new direction for visual arts research. At the 2020 China Digital Humanities Annual Conference, multiple experts affirmed the current leading role of libraries, museums, and archives in infrastructure construction, even arguing that the public welfare nature of these institutions and their accumulated data foundation over the years determines their necessary dominance [50]. Based on this, at the institutional level, art academy libraries should become the main body constructing demand-oriented visual arts digital humanities infrastructure. Art academies should closely focus on their disciplinary construction and research needs, formulate digital humanities development plans, establish visual arts dig-

ital humanities research centers, with library, museum, and archive scholars and visual artists jointly participating and collaborating in project-based development of visual arts basic data platforms, research tools, and service platforms, which will powerfully promote the transformation of visual arts research paradigms and create a new situation in new liberal arts construction.

4.2 Strengthening Deep Development of Existing Art Feature Databases

Regarding current art characteristic databases, we need to consider how to use digital technology for platform function upgrades, achieve more granular knowledge extraction from existing digital resources, realize segmentation and connection between knowledge points, and upgrade characteristic databases from resource service platforms to content service platforms. For example, building artwork graphs centered on individual artists to visually analyze artists' creative characteristics through digital statistics, or building knowledge graphs of relevant literature and artworks centered on specific art schools to visually explore the development and evolution of art schools. In short, using digital technology to further mine art characteristic resources and achieve connections between text and text, and between text and artwork images, will be new trends and directions for future visual arts research.

4.3 Developing Digital Humanities Education and Training

Digital humanities education is the core force for maintaining vitality and sustainability in the digital humanities field [51]. Digital humanities work is inherently collaborative, with scholars from different disciplinary backgrounds jointly completing research projects. To enable participants to better understand each other's thinking, they need to possess two types of professional literacy: humanities literacy and digital literacy. Taking visual arts as an example, visual arts scholars should possess not only professional knowledge but also certain digital literacy, i.e., data collection, data analysis, and data application capabilities, enabling them to find appropriate digital technology tools and methods for academic research. On the other hand, library, museum, and archive scholars or computer experts also need knowledge in visual arts-related fields to communicate effectively with visual arts scholars, accurately understand their real needs, and better serve as bridges in digital humanities practice, guiding visual arts scholars to use digital methods for academic research. Currently, digital humanities education both domestically and internationally has developed relatively mature experiences and methods for reference. Common education and training models include online platform education, project-based research education, and short-term training education [52]. In the process of visual arts digital humanities infrastructure construction, appropriate methods can be selected for digital humanities education and training based on actual conditions.

4.4 Establishing a Coordinated Construction Mechanism for Visual Arts Digital Humanities Achievements

Currently, major art academy libraries in China have developed their own art characteristic databases, but most are only accessible within their institutions' IP address ranges, resulting in narrow audiences and low social benefits of resources. Resource sharing and achievement sharing are major trends in digital humanities. Therefore, under the coordination and guidance of national professional academic institutions, establishing a coordinated co-construction mechanism for visual arts digital humanities achievements is very necessary. By building a collaborative promotion mechanism, we can achieve cross-institutional and cross-disciplinary academic exchange and resource sharing, explore sustainable co-construction models for visual arts digital humanities, and determine common technical specifications and metadata standards. On this basis, we can share established foundational data resources such as data format specifications, data naming conventions, and artist databases. Additionally, sharing universal tool software and system platforms will benefit innovative visual arts digital humanities research and effective resource utilization, further promoting the co-construction and sharing of digital humanities infrastructure in the visual arts field.

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Note: Figure translations are in progress. See original paper for figures.

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