

# Digital Transmission of Traditional Painting in the New-Media Era: Taking “Digital Dunhuang” as an Example

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**Abstract:** The advances in new-media technology have opened new possibilities for protecting and disseminating cultural heritage such as traditional painting. Taking Digital Dunhuang as an example, this paper summarizes its origins and digital dissemination methods through a literature review and data analysis, then focuses on audience cognition and interactive feedback under new-media dissemination and evaluates its impact on cultural communication and public art education. Results show that Digital Dunhuang, relying on a high-definition image library, social media, mini-programs and virtual-reality experiences, brings Dunhuang art to life in digital form and significantly broadens the audience and social influence. High levels of participation and positive responses on social media show that the public recognizes this mode of digital dissemination. However, technological upgrades and the accurate conveyance of cultural connotations remain challenges. To ensure the continued inheritance and innovation of traditional culture, cultural relics must be protected while technological innovation, richer interactive forms and open sharing of digital resources are continually promoted.

**Keywords:** New media; Traditional painting; Digital Dunhuang; Digital transmission; Cultural communication

## Introduction

The rapid development of new-media technology has provided completely new ideas for protecting and disseminating traditional cultural heritage. Presenting rare art forms digitally not only overcomes temporal and geographical limitations but also allows more people to deeply understand the essence and charm of ancient painting. Since the late twentieth century the Dunhuang Academy has explored the digital acquisition and management of murals in the Mogao Caves, seeking long-term preservation paths for ancient art. As the internet and social media become more pervasive, the Digital Dunhuang project has gradually moved beyond the professional research community; through various new-media channels it targets the general public and has formed an on-line-offline dual-drive model for cultural-relic protection and cultural promotion.

Existing research and news reports mostly discuss the value and potential of cultural-heritage digitization from perspectives such as digital acquisition and management, virtual-reality technology and cultural-creative industries ([Gansu Release, 2023](#); [Wang, 2022](#); [Peng, 2022](#)). Scholars have also studied the system architecture and back-end data

management of the Digital Dunhuang resource library, focusing on fast browsing of high-resolution images, database optimization and scalability ([Yu et al., 2020](#)). However, these studies mainly focus on technical implementation or protection of the relics themselves; systematic evaluation of user cognition, interactive experience and social dissemination effects in the new-media environment is still lacking. There is still room to explore the “breaking-the-circle” transmission of digital culture and its impact on public art education. Therefore, this study extends the perspective to audience participation and feedback on new-media platforms, aiming to explore how Digital Dunhuang seeks a balance between technological innovation and deep cultural inheritance and to evaluate, through empirical analysis, the effectiveness and challenges of digital transmission.

## Digital Dunhuang Project Overview Origin and development

The murals and painted sculptures of the Mogao Caves in Dunhuang are treasures of Chinese traditional painting. Because of their remote location and the fragility of the relics,

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they have long faced the dual difficulty of protection and dissemination. The concept of digitizing Dunhuang culture was first proposed in the late 1980s, and over the following decades digital preservation achieved significant progress and many results. By the end of 2021 the Digital Dunhuang Project had completed digital capture of 268 caves, image processing of 164 caves and three-dimensional reconstruction of forty-five colored sculptures, 146 caves and seven large sites; a specialized technical team of more than one hundred people participated ([Xinhua, 2022](#)). After years of exploration the project has gradually developed and improved. Researchers use high-definition photography and 3-D scanning to acquire and archive murals and sculptures of the Mogao Caves, creating a vast digital repository. With the rise of the internet the project expanded from data preservation to dissemination directed at the public. In 2016 the Dunhuang Academy officially launched the Digital Dunhuang resource-library website. The first batch of high-definition digital images of classic caves was opened to the world, marking the first time that high-precision digital images and panoramic tours of thirty caves were freely shared globally and visited more than seven million times from over ten countries ([Yu et al., 2020](#)). This marked a new stage: the project now serves not only academic research but also provides cultural sharing for society at large. Its development is inseparable from support from various sectors. At the end of 2017 the Dunhuang Academy and Tencent launched the “Digital Silk Road” initiative, bringing the technological and platform advantages of internet enterprises into the cultural-heritage field. Integration into this new cultural-and-creative ecology has spawned a series of innovative sub-projects. For example, the Digital Sponsors public-interest project launched in 2018 borrows the concept of ancient benefactors; netizens donate only 0.9 yuan to participate in digital preservation of the Mogao Caves ([Peng, 2022](#)). These explorations provide continuous momentum for the project. National policies supporting the digitization of cultural heritage also offer a favorable external environment. By the end of 2022 the project had completed digital capture and high-precision image processing of hundreds of caves and three-dimensional reconstruction of some sculptures and caves ([CGTN, 2023](#)). In April 2023 the Digital Library Cave officially went online, an immersive online museum that uses digital scanning and 3-D modeling to faithfully reproduce the library cave ([Gansu Release, 2023](#)). After decades of practice, Digital Dunhuang has evolved from digital preservation to digital dissemination and radiates new vitality in the new era.

### Digital dissemination methods

With the development of new-media technology, the Digital Dunhuang project continually innovates its dissemination methods and has built a comprehensive, multi-channel digital dissemination system.

Online sharing of high-definition resources. Through the project’s official website and related digital platforms, the public can freely browse high-definition mural images and panoramic tours of the grottoes. Dozens of classic caves have

achieved full-cave high-definition imaging and three-dimensional panorama sharing worldwide ([Gansu Release, 2023](#)). Users need only a computer or mobile device to appreciate the details of thousand-year-old murals as if on site. This online virtual tour breaks geographical and temporal limits and brings traditional art into daily life.

Social media platforms. Social media has become an important dissemination battleground. Since establishing its New-Media Centre in 2018, the Dunhuang Academy has actively operated WeChat public accounts, Weibo, Douyin and other platform accounts, regularly releasing rich digital content. Popular-science articles such as the Dunhuang Seasons and Festivals series use traditional festivals as entry points to introduce the cultural meanings of Dunhuang art, enhancing public understanding ([Peng, 2022](#)). On short-video platforms the academy created the virtual figure “Dunhuang Fairy – Jiayao” and in 2022 launched the animated series Dunhuang Fairy and Her Friends. Jiayao’s image is based on the kalaviṅka in Dunhuang murals; combining it with modern cartoon style shortens the distance to young viewers. The series tells stories about Dunhuang culture and relic protection and, after release on Weibo, Bilibili, Douyin and other platforms, received widespread praise and became a new media vehicle for disseminating Dunhuang culture ([Wang, 2022](#)). Topics and short videos on the academy’s official Weibo and Douyin accounts repeatedly topped trending lists, letting the sleeping caves “fly out of the Gobi” and enter the online public sphere.

Mobile applications and mini-programs. Mobile apps and mini-programs expand interactive dissemination. In 2020 the Dunhuang Academy and Tencent jointly launched the Cloud Tour Dunhuang WeChat mini-program. Users can select caves for panoramic roaming on their phones and click mural details to obtain explanations, realizing “cloud tourism.” Within ten days of launch total visits exceeded five million—far exceeding the annual on-site visitor numbers of the Mogao Caves ([Yangguang Net, 2021](#)). This digital product enables more people to conveniently experience the beauty of Dunhuang art. In subsequent operation the mini-program continuously enriches its content, adding routes with different themes, quizzes and other features that greatly increase user stickiness. Statistics show that from its launch in 2020 to the end of 2022 the mini-program recorded over sixty million visits and more than two hundred million interactive participations ([Liu, 2022](#)). This phenomenon-level dissemination product has significantly broadened the audience for Dunhuang culture.

Immersive and interactive experiences. Immersive experiences such as virtual reality (VR) have also opened new dissemination space for the project. The Dunhuang Academy cooperated with technology companies to launch the “Exploring Dunhuang — Digital Dunhuang Immersive Exhibition,” creating an online-offline interactive experience centered on Cave 285 of the Mogao Caves. Online, viewers can obtain knowledge through role playing; offline, wearing VR headsets they can freely “fly” through the cave and even immerse themselves in mural plots. Reports show that since its launch in 2023 this VR immersive exhibition has become a “hit”

project at the Mogao Caves scenic area and is particularly popular with young people ([Gansu Release, 2023](#)). This indicates that digital technology is bringing traditional cultural dissemination into a new stage of integration between the virtual and the real. The project also uses augmented-reality and holographic projection technologies in offline exhibitions to display mural art, providing audiences with rich new-media interactive experiences.

By fully utilizing digital imaging, social media, mobile internet and immersive technologies, the Digital Dunhuang project realizes panoramic dissemination of traditional painting from physical to virtual spaces. Supported by a new-media matrix, Dunhuang art crosses time and space to approach the public, and cultural heritage bursts forth with new vitality in digital form.

## Audience Participation in New-Media Dissemination

### Audience cognition and acceptance

Dissemination of the Digital Dunhuang project on new-media platforms has greatly enhanced public awareness of Dunhuang art. In the past, because of geographical limitations, many people's impressions of the Mogao Caves remained in books or documentaries, lacking direct insight. Through the project's online resources and interactive content, audiences thousands of kilometers away can view exquisite murals at zero distance, deepening their understanding of the value of Dunhuang culture. Many netizens, after viewing high-definition digital murals, say they "feel as if standing in the cave" and marvel at the detail and color of ancient painting. Digital Dunhuang has allowed what was originally niche grotto art to "fly into ordinary homes"; the public's perception has shifted from unfamiliarity to familiarity and affection. In terms of acceptance, the project's digital dissemination has generally won widespread praise and positive feedback. User surveys and online comments show that many audiences believe the digital content makes up for the regret of not being able to visit on site and allows them to access sophisticated traditional art more easily. Media such as Yicai note that the academy's new-media creative projects frequently generate hot discussions and become "creative hits" in the cultural-heritage field ([Peng, 2022](#)), reflecting the public's acceptance and pursuit of this innovative dissemination form. Young audiences, in particular, show strong interest in digital content that blends animation and game elements. For example, the short-video series featuring the virtual IP figure Jiayao has accumulated over ten million views; since the series Dunhuang Fairy and Her Friends began releasing on Weibo, Bilibili, Douyin and Kuaishou on 1 January 2022 it has received high recognition from all sectors of society and is especially loved by teenagers, with the hashtag #Dunhuang Fairy and Her Friends# on Weibo garnering five million reads ([Wang, 2022](#)). This phenomenon shows that through cartoon imagery and narrative expression, traditional mural art successfully "wins fans" among young audiences and enhances their affinity for and acceptance of Dunhuang culture.

From an emotional perspective, the project evokes public pride and resonance with traditional culture. Many netizens leave messages praising Dunhuang art and calling the project "digital guardianship of national treasures," seeing it as a pioneering effort to bring Chinese cultural heritage to the world. Some netizens who participate in the Digital Sponsors project are proud of being "digital sponsors," gaining a sense of cultural identity while supporting relic digitization. Audiences' positive attitudes are also evident in the plethora of spontaneous secondary creations. Designers and comic enthusiasts use open digital materials to create derivatives covering fashion, games and other fields and disseminate them widely on social platforms. This indicates that audiences not only passively accept digital content but also actively participate in the re-creation and dissemination of Dunhuang culture, demonstrating strong recognition and enthusiasm. Overall, in the new-media era Digital Dunhuang has built a solid audience base and reputation. The public has moved from curious spectators to active participants spreading Dunhuang aesthetics, showing that digital transmission of traditional painting has been accepted by society. The project has cultivated new audience groups and achieved an effective connection between traditional art and contemporary audiences.

### Interactive dissemination mode and feedback analysis

In the new-media environment, dissemination is no longer a one-way release of information; it emphasizes audience interaction. Digital Dunhuang makes full use of interactive dissemination modes to mobilize audience enthusiasm, realizing a virtuous cycle between disseminators and audiences. Based on actual data, we analyze dissemination performance and audience feedback on social media.

Coverage. Across major platforms the project has achieved remarkable coverage. Taking the Cloud Tour Dunhuang mini-program as an example, by the end of 2022 it had recorded more than sixty million visits and over two hundred million interactive participations ([Liu, 2022](#)). Such huge user engagement far exceeds the annual offline visitor numbers to the Mogao Caves, showing that digital dissemination enormously expands the audience. On Weibo, topics released by the academy also attract massive attention. A special article by the National Cultural Heritage Administration notes that the series of creative projects has made the academy "go viral," bringing Dunhuang culture into thousands of households ([National Cultural Heritage Administration, 2021](#)). From a macro perspective, Dunhuang-related digital content produces "break-the-circle" dissemination effects in mainstream media. In 2021 the city of Dunhuang launched the topic #How Beautiful Is Dunhuang# on platforms such as Weibo and Douyin, accumulating nearly 4.5 billion reads ([Dunhuang Release, 2021](#)). Although this figure includes promotion of the city's overall image, it also confirms the enormous influence of Dunhuang-related content on new media.

Interaction depth. Audience feedback on Digital Dunhuang content is enthusiastic, forming a highly interactive dissemination ecology. User interaction mainly involves likes, comments, shares and participation in activities. On Douyin, short

videos about Dunhuang frequently become “hits.” For example, a video of Dunhuang middle-school students doing a Dunhuang-style dance during a break went viral, with cumulative views exceeding two hundred million across accounts, more than 2.57 million likes and over 110 000 comments ([Dunhuang Release, 2021](#)). Many users leave comments such as “So beautiful” and “I want to learn this dance,” showing strong willingness to participate. Likewise, after the series *Dunhuang Fairy and Her Friends* was released, the related topic reached five million reads, and many viewers left bullet messages and comments to interact with the creators, ask questions or express affection ([Wang, 2022](#)). In the *Cloud Tour Dunhuang* mini-program, users not only browse but also actively participate in quizzes, like their favorite murals and engage with other interactive functions; during the first three weeks after launch the mini-program collected hundreds of thousands of likes and comments (data from the project’s operation report). These interaction data show that audiences are not passive but deeply involved in the dissemination process, forming a positive two-way dialogue.

Analyzing audience feedback helps clarify the dissemination effect of Digital Dunhuang. Overall, positive feedback accounts for an absolute majority. Many audiences express gratitude, saying the project “lets us see national treasures we couldn’t see” and praising digital technology. In quiz interactions many users show interest in Dunhuang cultural knowledge, eagerly answering questions and sharing the digital certificates they obtain, which strengthens a sense of achievement and stickiness. From the questions raised, audiences care not only about the mural images themselves but also about the historical stories and cultural meanings behind them. This suggests that the project’s dissemination has stimulated audiences’ desire to explore deeper content. Some feedback also offers suggestions for improvement: people hope for more caves to be digitized, higher image clarity or an English version for overseas users. These suggestions provide valuable user perspectives for optimizing the project. The above data analysis shows that Digital Dunhuang achieves both broad coverage and deep interaction in new-media dissemination. On the one hand, huge viewing and topic-reading figures demonstrate strong dissemination power; on the other hand, high numbers of likes, comments and user-generated creations show audience enthusiasm and stickiness. Positive feedback is reflected not only in growth of digital metrics but also in enhanced cultural cognition and emotional resonance. In sum, the interactive dissemination mode explored by Digital Dunhuang effectively promotes the living transmission of traditional culture in the network age.

## Impact and Challenges of the “Digital Dunhuang” Project

### Promotion of cultural dissemination and public art education

The successful practice of Digital Dunhuang has significantly promoted cultural dissemination and public art education.

**Cultural dissemination.** The project has pioneered new ways to “make traditional cultural heritage come alive and go out.” With the aid of digital technology, Dunhuang art—once sealed in the northwest desert—has reached both national and global audiences. Tens of millions of netizens have appreciated the murals through online channels, and many of them previously knew little about Dunhuang art. In effect, Digital Dunhuang converts potential audiences into real ones, greatly improving social awareness and influence. As the Dunhuang Academy’s secretary Zhao Shengliang said, they hope that through Digital Dunhuang more people can feel the charm of Dunhuang, appreciate the outstanding achievements of Chinese traditional culture, improve artistic appreciation, strengthen cultural confidence and, under new historical conditions, promote exchanges between different cultures along the Belt and Road ([Xinhua, 2022](#)). This shows that the project plays a positive role in disseminating excellent traditional culture and enhancing national cultural identity.

**Public art education.** The project also has important value in public art education. First, it provides high-quality aesthetic resources. Previously, only those who visited the Mogao Caves could directly experience the murals; now students, art enthusiasts and even ordinary netizens can conveniently view and study the composition, colors and techniques of classic murals through Digital Dunhuang. This greatly benefits the improvement of artistic appreciation and aesthetic literacy. Many art teachers integrate the project’s resources into classroom teaching, using high-definition images to explain the essence of Chinese ancient painting and stimulate students’ interest in traditional art. Some parents report that after watching Dunhuang animations and playing interactive games, children develop strong interest in history and art and proactively ask to learn Dunhuang stories. This indicates that the project not only disseminates culture but also, imperceptibly, conducts public art education. The project also spurs the creativity and participation of younger generations. The launch of an open material library allows creators worldwide to obtain Dunhuang elements for secondary creation, turning cultural resources into creative products. Many children participate by copying digital murals or making related handicrafts, cultivating their closeness to traditional culture and hands-on abilities.

**Educational demonstration and tourism integration.** The project provides a model for cultural-heritage education. In recent years the Dunhuang Academy has held various “Dunhuang Art Exhibitions” and “Digital Dunhuang Exhibitions” in more than twenty provinces in China and in countries such as the United States, France, Italy, Israel and Turkey. Examples include the “Silk Road Pearl·Digital Eternity” exhibition in Tel Aviv and the “Dunhuang Is No Longer Distant – Approaching Morocco” digital Dunhuang exhibition in Rabat; these combine online and offline approaches to spread Dunhuang culture and tell Chinese stories ([Qiu et al., 2024](#)). Other heritage sites such as the Yungang Grottoes have learnt from Dunhuang’s experience to speed up digital display and dissemination and develop digital products popular with young people ([Xinhua, 2022](#)). Thus, Digital Dunhuang plays a nationwide leading role in education promotion. Notably, the project

also promotes the integration of culture and tourism. By warming up audiences and spreading knowledge online, it attracts more people to visit the Mogao Caves in person. Some visitors first study the cultural background online and then enjoy a richer experience when they go on site. This model of “cloud guide + on-site tour” improves the depth and quality of cultural tourism ([Gansu Release, 2023](#)). In summary, Digital Dunhuang significantly expands the depth and breadth of traditional art dissemination and achieves notable results in promoting Chinese culture and popularizing aesthetic education.

### Challenges of digital dissemination and directions for improvement

Despite remarkable achievements, Digital Dunhuang faces many challenges in digital dissemination and needs continuous improvement.

**Technological challenges.** Digital technologies update quickly; how to continuously adopt the latest technologies to present Dunhuang art is a major issue. High-definition imaging and VR/AR technologies enhance the user experience but require substantial financial input and professional personnel for maintenance and upgrades. When technology standards advance, early digital images may lack sufficient resolution and need to be re-captured or algorithmically enhanced. Massive high-definition images and model data also require secure storage media and backup strategies to prevent data loss or damage. In addition, cross-platform compatibility and smooth access must be ensured so that users can easily obtain digital content. These technical issues necessitate establishing continuous technical support and iterative mechanisms to maintain dissemination quality and stability ([Gansu Release, 2023](#)).

**Accurate transmission of cultural connotations.** Dunhuang murals contain profound historical and religious meanings, and conveying these accurately through digital media is challenging. In the fragmented online environment, audiences often engage with content for entertainment and may ignore deeper cultural information. For example, when watching an animated short video, viewers may focus on interesting plots and overlook the Buddhist stories behind them. Content planners must balance being interesting and accessible with preserving the cultural essence. Because audiences have different knowledge backgrounds, the project needs to provide layered information—both popular introductions and detailed materials for enthusiasts—to meet diverse needs. It is also necessary to avoid excessive entertainment or commercialization that disrespects cultural heritage; some netizens worry that carbonizing solemn Buddhist art might reduce its sacredness. These factors remind the project team to respect the original appearance and meaning and maintain aesthetic quality and educational value while innovating expression.

**Interaction management and intellectual property.** Interaction management and intellectual property are also important challenges. The project encourages public interaction and secondary creation, but this brings problems in managing interactive content and copyrights. Large numbers of user comments and creations need moderation to prevent inap-

propriate speech or misinformation. Open material libraries provide shared resources but also risk misuse. The Dunhuang Academy has explored using blockchain technology to record the authorization and transactions of digital materials. Future work still needs to further improve digital copyright-protection mechanisms and strike a balance between encouraging creation and preventing abuse; this exploration has reference value for other cultural digitization projects ([Gansu Release, 2023](#)).

**Improvement directions.** To address these challenges, several improvements are proposed. First, establish a long-term and stable industry-academia-research cooperation mechanism to bring together scientific and cultural-heritage forces to tackle technical problems in digital capture and presentation, ensuring that Digital Dunhuang remains at the technological frontier ([Gansu Release, 2023](#)). Second, strengthen cross-disciplinary collaboration in content production: archaeological and art experts should ensure cultural accuracy, while new-media operators innovate expressive forms to enhance content quality. For some important mural stories, graded reading modes can provide multi-level content from introductory to in-depth to meet diverse audiences ([Gansu Release, 2023](#)). Third, enrich interaction forms to enhance user retention. Introduce gamified mechanisms, such as online games and quizzes themed on Dunhuang culture, to deepen memory through fun; establish mechanisms to collect and respond to user feedback, regularly analyzing audience data and suggestions to optimize the product experience ([Gansu Release, 2023](#)). Fourth, while deepening openness and sharing, expand partnerships. Beyond existing internet companies, cooperate with educational institutions and the creative industry to apply Dunhuang digital content to art teaching and cultural-creative design, thereby expanding influence. On the premise of copyright protection, encourage diverse secondary creations to empower the modern transformation of traditional culture ([Gansu Release, 2023](#)). Finally, pay attention to coordination between digital dissemination and physical protection. Digitization should not replace the value of real relics but should feed back into protection. Diverting visitors and planning more scientific visitation schemes through digital means can reduce pressure on the caves. Such positive interaction will realize mutual reinforcement between “digital inheritance” and “physical protection.” In essence, facing the opportunities and challenges of the new-media era, Digital Dunhuang needs to innovate while adhering to its cultural roots and continuously adjust its dissemination strategies. Only through continuous improvement can this treasure of traditional painting shine with lasting vitality in the digital era.

### Conclusion

Digital Dunhuang is a pioneer and a typical case of digitally transmitting traditional painting. This study draws several conclusions. First, digital technology provides unprecedented possibilities for protecting and disseminating traditional cultural heritage. By using high-definition imaging, virtual reality and internet platforms, the project overcomes

time and space constraints, brings the Dunhuang art long hidden in the mountains into public view and broadens the dimension of cultural dissemination. Second, interactive communication under the new-media environment effectively enhances dissemination effects. Through social-media operations and audience participation, the project has shifted from “one-to-many” broadcasting to “many-to-many” interaction, greatly increasing audience participation and identification. Massive online visits and counts of likes and comments fully prove that the public highly appreciates this digital transmission method. Third, the project has achieved remarkable results in promoting public aesthetic education and spreading traditional culture. It has attracted numerous young people interested in Dunhuang art and set a benchmark for digitalization of other cultural heritage. Nevertheless, digital transmission is not without obstacles: technical updates, content regulation and copyright management remain challenges. Therefore, the project team must continue to innovate and manage prudently to balance dissemination breadth and cultural depth. Future work suggests that Digital Dunhuang should continue to deepen cooperation with the technology and education sectors, develop richer digital products—such as immersive interactive games and AI narration assistants—to attract new generations and strengthen international dissemination so that Dunhuang digital resources serve global art-history research and cross-cultural communication. Under the premise of ensuring the safety of relics, more high-resolution materials should be appropriately opened to encourage co-creation and form a vivid atmosphere in which everyone participates in cultural transmission. Overall, the path of digitally transmitting traditional painting in the new-media era has broad prospects. The experience accumulated by Digital Dunhuang will provide valuable references for similar projects. We have every reason to believe that, with the wings of digital technology, Dunhuang art and the treasures of Chinese culture will remain fresh for a long time and be passed down through generations.

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