Art Horizons
ISSN Print: 3079-5176
ISSN Online: 3079-5184
https://doi.org/10.63313/ah.9018

Research on Protection and Restoration of the Paintings in Yongle Palace Based on the Theory of Dynamic Conservation

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How to cite this paper: ZHENZHEN, Bayartur Baljinnyam, & Battsooj Sukhbayar. (2025). Research on protection and restoration of the paintings in Yongle Palace based on the theory of dynamic conservation. Art Horizons, 1(2), 81–89. ISSN Print: 3079-5176; ISSN Online: 3079-5184.
https://doi.org/10.63313/ah.9018
Published: 2025-07-24

Abstract

This study takes the murals of Yongle Palace as the research object and uses the theory of dynamic protection to explore its protection and restoration strategies. Through literature review and on-site investigation, it analyzes the dynamic characteristics of traditional restoration techniques and the current challenges in their inheritance, and proposes innovative paths such as digital protection, integration of technology and traditional craftsmanship, and community participation. The study finds that the theory of dynamic protection provides new ideas for the sustainable protection of the murals of Yongle Palace. While respecting the essence of traditional craftsmanship, it realizes the activation of cultural inheritance through modern technological means and community participation. The research results provide theoretical references and methodological inspirations for the protection practice of large-scale mural cultural heritage in China.

Keywords

Yongle Palace murals; Live protection; Restoration techniques; Digital protection; Community participation

1. Introduction

The murals of Yongle Palace, as the largest existing group of ancient temple murals in China, possess extremely high artistic value and historical significance. These murals, painted during the Yuan Dynasty, not only showcase the superb painting skills of that time, but also carry rich religious culture and folk art traditions (Ru Qi, 2020). However, over time and due to environmental changes, the murals have faced varying degrees of damage and aging problems, making the protection work particularly urgent. Traditional methods of mural protection mainly focus on physical restoration and technical intervention, although they have to some extent slowed down the deterioration of the murals, they often neglect deeper issues such as the inheritance of skills and the continuation of cultural traditions (Wang Yan Song, 2024).

In recent years, with the development of the concept of cultural heritage protection, the theory of dynamic protection has gradually gained attention from the academic community. This theory emphasizes that while protecting the physical carriers, more attention should be paid to the inheritance and development of related knowledge and skills systems (Qiu Yuan, 2024). The theory of dynamic protection provides a new perspective for the protection of the murals of Yongle Palace. Unlike static protection, dynamic protection not only focuses on the physical preservation of the murals, but also attaches importance to the inheritance of restoration techniques, the interpretation of cultural connotations, and the promotion of community participation (Wu Chen et al., 2024). This comprehensive protection concept helps to achieve the transformation of the protection of the murals of Yongle Palace from simple material protection to overall cultural protection. This study aims to explore the application value of the theory of dynamic protection in the protection of the murals of Yongle Palace, analyze the main problems existing in the current protection work, and propose corresponding countermeasures and suggestions. Through the combination of theory and practice, it provides new ideas and methods for the protection of large-scale mural cultural heritage.

2. Literature Review

2.1. Research on the Murals of Yongle Palace

Regarding the research on the murals of Yongle Palace, the academic community has accumulated a wealth of achievements. The early studies mainly focused on the artistic style and the interpretation of the images. Qu Lián (2024) systematically reviewed the research on Yongle Palace in the Western academic circle, pointing out that international scholars mainly analyzed the content of the murals from the perspectives of art history and social history. Ru Qi (2020) conducted a detailed study on the techniques and color composition of the murals, arguing that they inherited the traditions of Tang and Song painting while having characteristics of the Yuan Dynasty. These foundational studies provided important references for understanding the artistic value of the murals.

In terms of protection technology research, Wang YanSong (2024) analyzed the drawing techniques of the murals from the perspective of material media, stating that the traditional construction of the undercoat layer and the use of mineral pigments are the key factors for maintaining the durability of the murals. Song Hui et al. (2024) explored the architectural features of Yuan Dynasty dwellings through the architectural images in the murals, providing a new perspective for understanding the historical background of the murals. These studies deepened the understanding of the material composition of the murals and laid a technical foundation for the protection work.

In recent years, some scholars have begun to focus on the innovative application of the murals in Yongle Palace. Zhang Meibin (2024) studied the transformation of

mural patterns in modern design, Wang Wenjie (2025) explored the application value of mural patterns in sustainable packaging. Wang Xin and Zhang Huichao (2025) attempted to develop mural IP images based on the theory of cultural memory. These studies have expanded the modern interpretation of the value of the murals, but there is still a lack of depth in the combination of traditional culture and modern application.

2.2. Research Related to Theory of Dynamic Conservation

The theory of dynamic conservation emphasizes the continuation of cultural heritage's vitality through dynamic development. Its core proposition is to achieve creative transformation of cultural traditions within the contemporary life context. This theory breaks through the limitations of static preservation and advocates through community participation, productive protection, and adaptive reuse, that cultural heritage maintains its core value in functional continuation and form evolution. Dynamic conservation emphasizes three key dimensions: the subject dimension, the time dimension, and the space dimension. At the practical level, through digital transformation, educational inheritance, and creative industry integration, a self-renewal mechanism for cultural heritage is formed. Currently, the academic community generally believes that the theory of dynamic conservation provides methodological guidance for handling the tension between tradition and modernity, and its "dynamic balance" concept has become an important paradigm in the international field of cultural heritage protection. This theory has shown special value in the practice of intangible cultural heritage protection in China, especially in the revitalization of traditional crafts and the construction of village cultural ecological protection areas. There are many application cases of the theory in the field of cultural heritage. Wu Chen et al. (2024) applied this theory to the protection of the Great Wall ruins and proposed a design concept for interactive museums. Zhou Quan and Zhang Zhao Yuan (2024) took Liuting Town in Guilin as an example to explore the dynamic protection strategies for traditional villages. Qiu Yuan (2024) studied the specific practice ofintangible cultural heritage dynamic conservation through the case of the clay gold and lacquer painting technique. These studies provide empirical support for the development of the theory of dynamic conservation.

The existing research has three main limitations： Firstly， the research on the murals of Yongle Palace focuses mainly on artistic analysis and material protection，with insufficient attention to the dynamic inheritance of restoration techniques； Secondly， the application research of the theory of dynamic conservation in mural heritage is relatively lacking； Thirdly， there is a lack of a systematic evaluation system for protection effects. This study will focus on exploring how to guide the overall protection of the murals of Yongle Palace through the theory of dynamic conservation， and propose innovative solutions in terms of technique inheritance，cultural continuation， and social participation.

3. Analysis of the Dynamic Nature of the mural Restoration Techniques in Yongle Palace

3.1. Traditional Craftsmanship Process System

The traditional restoration techniques of the murals in Yongle Palace embody a complete knowledge system, which has been formed through the practical accumulation of generations of artisans. The technique of making the ground layer is the fundamental step in mural restoration. Craftsmen use local specific soil mixed with hemp fibers, wheat straw and other fibrous materials, and through repeated pounding, drying and other processes, finally form a base with good adhesion and breathability. This traditional technique not only takes into account the physical properties of the materials, but also incorporates a profound understanding of the local climate environment (Wang Yan Song, 2024).

In terms of the mixing of mineral pigments, traditional artisans possess unique formulas and techniques. They extract colors from natural minerals, make pigments through grinding, rinsing and other processes, and add an appropriate amount of adhesive material to ensure the durability of the colors. It is worth noting that pigment mixing is not just a simple technical operation, but also integrates a profound understanding of the artistic style of the murals. Craftsmen need to adjust the concentration and composition of the pigments according to the different parts and content of the murals to achieve the best visual effect (Ru Qi, 2020). The line sketching technique in the mural restoration process is particularly exquisite. Craftsmen use specially made brushes to repair damaged lines with steady strokes, while maintaining the charm of the original lines and ensuring the coordination and unity of the repaired part with the whole. The mastery of this technique requires not only long-term manual training, but also an in-depth understanding of the language of mural art. The traditional apprenticeship system plays an irreplaceable role in this technique inheritance, passing on complex technical details and aesthetic standards from generation to generation through oral instruction and heart-to-heart teaching.

3.2. Current Problems of the Protection and Development of the Paintings in Yongle Palace

Currently, the transmission of the mural restoration techniques in Yongle Palace is facing severe challenges. The most prominent problem is the crisis of the gap in the transmission of skills. The older generation of skilled craftsmen who have mastered the complete traditional restoration techniques are getting older, while the number of young learners is seriously insufficient. This situation puts many delicate techniques at risk of being lost (Qiu Yuan, 2024). The reasons for this situation are complex and diverse, including changes in the social status of traditional handicrafts and the influence of economic benefits, etc.

The trend of material standardization also poses a challenge to traditional techniques. In modern restoration work, standardized materials produced by industrialization gradually replace traditional handcrafted materials. Although these standard materials are convenient to use and have stable performance, they differ in texture and expression effect from traditional materials, which may affect the artistic integrity of the restoration work (Wang Yansong, 2024). How to maintain the characteristics and techniques of traditional materials while ensuring the quality of restoration is a problem that urgently needs to be solved. The imperfect professional training system is also a constraint. The existing education system has limited settings for mural restoration and the course content often focuses on theoretical knowledge and modern technologies, with insufficient in-depth teaching of traditional techniques. This leads to obvious shortcomings in the traditional techniques mastery of the trained professionals (Wu Chen et al., 2024). At the same time, the lack of practical opportunities makes it difficult for learners to obtain sufficient technical practice. The insufficient social recognition also affects the transmission of the techniques. The public's limited understanding of the value of traditional restoration techniques and their lack of deep knowledge of the cultural connotations and technical essence of the techniques have not only affected the learning enthusiasm of the younger generation but also hindered the formation of a social atmosphere supportive of the transmission of the techniques (Zhou Quan et al., 2024).

3.3. Practical Exploration of Living Heritage Transmission

In the face of these challenges, some positive practical explorations are underway. Digital technology plays a significant role in documenting and disseminating skills. Through technologies such as high-definition image capture and three-dimensional scanning, the key steps of traditional restoration techniques can be fully recorded. These digital archives not only provide a reliable medium for preserving skills, but also create conditions for remote teaching and academic research (Wang Xin et al., 2025). It is worth noting that the digitalization work particularly focuses on comprehensive recording of process details and cultural context, avoiding simple technical extraction.

The innovative combination of modern education systems and traditional apprenticeship systems is another important attempt. Some universities have begun to collaborate with experienced artisans to offer traditional craft courses, integrating practical skills into the formal education system. This model maintains the personal experience characteristic of apprenticeship while leveraging the educational resources of schools to expand the scope of inheritance (Sun Yuyu, 2023). In the teaching process, particular emphasis is placed on the combination of theory and practice. Through the analysis and operation of actual restoration cases, students deepen their understanding of the principles of the skills. The establishment of a community participation mechanism has injected new vitality into the inheritance

of skills. By holding workshops, public demonstrations, and other activities, inviting community residents to participate in simple restoration experiences, it not only enhances public awareness of traditional skills but also cultivates potential interest groups for the inheritance of skills (Zhou Quan et al., 2024). These activities particularly focus on the transmission of cultural connotations, allowing participants to experience the cultural value of traditional craftsmanship through hands-on practice. International exchanges and cooperation also provide new perspectives for the inheritance of skills. Through cooperation with relevant foreign institutions, not only advanced protection concepts and technologies are introduced, but also through comparative studies, the unique value of traditional restoration skills in China is deepened (Qu Lian, 2024). This exchange is not a simple technology transplantation, but a mutual reference based on cultural dialogue.

Although these practical explorations have achieved certain results, they still face many challenges. Issues such as how to balance the relationship between tradition and innovation, how to maintain the authenticity of skills in the process of modernization, and how to establish a sustainable inheritance mechanism, all require further exploration and improvement in future practices. The concept of dynamic protection provides important ideas for solving these problems, but the specific implementation path still needs to be continuously adjusted and optimized in light of the actual situation of the Yongle Palace murals.

4. Practical Strategies for the Dynamic Protection of the Mural Art in Yongle Palace

4.1. Digital Archive Construction and Knowledge Management

Establishing a systematic digital archive is the fundamental work for implementing dynamic conservation. This task requires the use of multi-dimensional recording methods, which not only include high-definition image collection of the mural itself, but also should cover the entire process of the restoration techniques. During the specific implementation process, attention should be paid to the compilation of the oral history of the artisans, converting the implicit knowledge that has not yet been recorded in writing into shared explicit knowledge. The construction of the digital archive needs to follow professional standards to ensure the long-term readability and traceability of the data. At the same time, an open knowledge management platform should be established to enable these precious materials to be utilized by researchers, educational institutions, and the public. It is worth noting that digitalization work must respect the traditional knowledge system and avoid the loss of cultural connotations due to technological intervention (Wang Yansong, 2024).

4.2. Organic Integration of Traditional Craftsmanship and Modern Technology

In the practice of conservation, it is necessary to actively explore the collaborative

innovation model between traditional craftsmanship and modern technology. Modern analytical techniques can help us gain a deeper understanding of the characteristics of traditional materials, providing scientific basis for process improvement. For instance, through material composition analysis, we can precisely determine the ratio of traditional pigments; through environmental monitoring technology, we can provide data support for the selection of restoration materials. However, the application of technology must be based on respecting the value of traditional craftsmanship and cannot simply replace traditional skills with modern methods. The ideal state is to form a complementary advantage between tradition and modernity: traditional craftsmanship retains its cultural characteristics, while modern technology provides auxiliary solutions. This integration requires conservators to have a cross-disciplinary knowledge background and be able to find a balance point between the two (Ruchik, 2020).

4.3. Innovative Construction of Community Participation Mechanisms

The core of dynamic conservation lies in integrating cultural heritage back into contemporary life, and community participation is the key to achieving this goal. Multi-level participation mechanisms should be designed to meet the needs of different groups. For professional groups, deep workshops can be organized to invite them to participate in the actual restoration process; for the general public, virtual experience opportunities can be provided through digital platforms. It is particularly important to cultivate the interest of the younger generation and incorporate mural art into the school education system, developing experience courses suitable for different age groups. Community participation should not be limited to passive acceptance; it should also encourage creative transformation. For example, support local artists to create contemporary works using mural elements, or organize community residents to participate in the design of derivative products. This participatory conservation can form emotional connections, making cultural heritage truly become an integral part of community identity (Zhou Quan et al., 2024).

4.4. Exploration of Sustainable Operating Models

The realization of dynamic protection requires the establishment of a long-term operational mechanism. This includes diversified funding channels, such as government special allocations, social donations, and revenue from cultural and creative products. In terms of management model, a governance structure involving multiple parties can be attempted, inviting government departments, academic institutions, and community representatives among other stakeholders to jointly make decisions. The cultivation of professional talent teams is the foundation for sustainable operation, and a complete system from basic education to vocational training needs to be improved. Additionally, a scientific evaluation mechanism should be established to regularly review the effectiveness of the protection work and promptly adjust

strategies. The key to sustainability lies in forming a virtuous cycle: protection achievements bring social recognition, social recognition transforms into support forces, and these support forces further promote deeper protection (Wu Chen et al., 2024).

5. Conclusion

This study systematically examined the current protection status of the murals in Yongle Palace and demonstrated the applicability of the theory of dynamic protection in the conservation of mural cultural heritage. The study found that traditional restoration techniques contain a rich knowledge system and cultural wisdom, and their dynamic inheritance is of great significance for the protection of murals. The main challenges currently faced include the gap in skill inheritance, the impact of material standardization, and insufficient social awareness. To address these issues, this study proposed practical paths such as digital protection, technological innovation, and community participation, emphasizing the need to balance tradition and modernity in the protection process and maintain the integrity of cultural expression. Future research can further explore the evaluation index system for the effectiveness of dynamic protection and the collaboration mechanism among different protection entities. With the development of technology, the application of new technologies such as artificial intelligence in the inheritance of traditional craftsmanship is also worthy of attention. The protection practice of the murals in Yongle Palace indicates that dynamic protection not only can preserve the material form of cultural heritage but also can activate its cultural vitality and provide spiritual resources for contemporary society. This concept and method also have reference value for the protection of other types of cultural heritage.

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