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Research on the Construction of Popular Science Bases from the Perspective of "Industrial Culture+" Ingratiation—Based on a Survey and Analysis of Hundreds of Popular Science Bases in Sichuan Province

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Abstract

This study focuses on the construction of popular science bases from the perspective of "Industrial Culture+" integration, taking hundreds of popular science bases in provinces and cities as the research objects. Through field surveys and analyses, it explores the development paths of popular science bases in the context of the new era. The study emphasizes that popular science bases should fully utilize industrial cultural resources and enhance public awareness and interest in industrial culture, especially among teenagers, through various means such as educational courses, interactive experiences, and community participation. Additionally, the study explores how to promote the inheritance and innovation of industrial culture through the construction of popular science bases and how to improve the public's scientific literacy through popular science activities.

Keywords

industrial culture, popular science base, integration mode

The "Industrial Culture+" popular science base integration perspective aims to build a multidimensional and interdisciplinary interactive platform for popular science on industrial culture themes by integrating traditional handicrafts, industrial heritage, modern industry, and comprehensive cultural resources. This framework not only focuses on the preservation and inheritance of industrial culture but also emphasizes its application and development in modern society. It aims to enhance the public's understanding of the value of industrial culture through popular science education while promoting the innovation and transformation of industrial culture. Through this integration mode, popular science bases can become

bridges connecting the past and the future, theory and practice, and education and entertainment, providing new impetus and direction for the sustainable development of industrial culture.

In China, with the increasing recognition of the value of industrial culture and the advancement of scientific and technological innovation, the integration mode of popular science bases has gradually shifted from a single exhibition to a diversified and highly interactive educational experience. For example, popular science bases in Sichuan Province have combined local industrial characteristics and cultural resources, such as Chengdu Shuijingfang Museum and Dongjiao Memory·Chengdu International Fashion Industry Park, to achieve a combination of industrial heritage and modern technology, enhancing public participation and educational effects. The domestic mode is characterized by emphasizing the inheritance and innovation of local culture and the popularization and democratization of popular science education. Internationally, especially in Western countries where the Industrial Revolution originated, the integration mode of industrial culture and popular science education is more mature. These countries usually have relatively complete laws and policies for the protection of industrial heritage and a more systematic industrial culture education system. For example, Iron-bridge Gorge Museum in the UK and Ruhr Area in Germany have successfully transformed into centers for industrial culture education and tourism by preserving and reusing industrial heritage.

1. Current Status of "Industrial Culture" Popular Science Bases

The "Industrial Culture" popular science bases in Sichuan Province are diverse and can be roughly classified into four categories: traditional handicrafts, industrial heritage, modern industry, and comprehensive culture:

(1) Traditional Handicrafts: Represented by Chengdu Shuijingfang Museum and Sichuan Hejiang Yongxingcheng Soy Sauce Culture Expo Park, these bases not only protect and display traditional handicraft skills but also allow visitors to feel the charm of traditional skills while understanding historical culture through interactive experiences.

(2) Industrial Heritage: Such as Dongjiao Memory·Chengdu International Fashion Industry Park and Panzhihua Lanjian Industrial Tourism Base, these bases transform abandoned industrial sites into culturally valuable tourist destinations, not only showcasing the development of industrial history but also incorporating modern fashion elements to achieve a perfect fusion of industry and culture.

(3) Modern Industry: Modern industrial bases such as FAW-Volkswagen Jetta Smart Factory and Chengdu Industrial Vocational and Technical College Industrial Expo Hall allow visitors to experience the charm of modern industry up close by displaying advanced production equipment and processes, while also popularizing relevant scientific knowledge.

(4) Comprehensive Culture: Bases like Science Fiction World Infinity organize activities such as science fiction art exhibitions and set up augmented reality observation stations, showcasing the charm of the fusion of technology and culture and injecting new vitality into popular science work.

2. Integration Practices of "Industrial Culture" Popular Science Bases

"Industrial Culture" popular science bases have achieved remarkable results in integration practices, mainly reflected in the following aspects:

2.1 Integration of Culture and Technology

"Industrial Culture" popular science bases not only focus on the popularization of scientific knowledge but also actively incorporate cultural elements. By organizing cultural activities and exhibitions, they allow visitors to feel the charm of culture while learning scientific knowledge. Taking Sichuan Science and Technology Museum as an example, as an important popular science education base in the southwest region, it carries the important mission of disseminating scientific knowledge and stimulating the public's interest in science. Sichuan Science and Technology Museum has theme exhibition areas such as "Three Questions" (Asking About Heaven, Water, and the Future), "Three Searches" (Searching for Knowledge, Wisdom, and Footprints), and "Three Lifes" (Life, Survival, and Living), with rich and diverse content covering multiple fields such as aerospace, water conservancy technology, life sciences, disaster prevention, and mitigation. The exhibits in the museum focus on interactivity and fun, presenting scientific knowledge to visitors in a vivid and engaging way through modern display means such as sound, light, and electricity. Some exhibits also include interesting experiments and game sessions, such as "Magnetic Turntable" and "Optical Labyrinth," allowing visitors to learn scientific knowledge while entertaining, greatly enhancing the fun and participation of the visit. At the same time, by regularly organizing popular science lectures, scientific experiment performances, popular science film screenings, and other activities, inviting experts and scholars to explain scientific knowledge to visitors, it attracts a large number of visitors to participate. This type of base is mainly targeted at teenage students, accounting for about 60% of the total number of visitors. In addition, there are some parents, teachers, science and technology enthusiasts, and foreign tourists. Visitors of different age groups and occupations have different needs and interests in the museum's exhibition content and activities. Teenage students are more focused on exhibits and activities with strong entertainment and good interactivity, such as robot performances and science experiment shows; parents and teachers are more focused on the educational function of the museum, hoping that children can learn scientific knowledge and cultivate scientific literacy and innovative thinking during the visit; science and technology enthusiasts and foreign tourists are more interested in the museum's cutting-edge technology displays and special exhibits.

2.2 Integration of Industry and Tourism

Many industrial heritage and modern industrial bases have been transformed and upgraded, converting abandoned industrial sites or modern production facilities into tourist destinations, attracting a large number of visitors to visit and experience. This integration not only promotes the development of tourism but also raises public awareness of science and industry. Taking Chengdu Dongjiao Memory as an example, Dongjiao Memory is located in Chenghua District, Chengdu, and was rebuilt based on the former Hongguang Electron Tube Factory site. The renovation process can be divided into three stages: renovation, construction, and operation. The renovation stage mainly involved protecting, reinforcing,

and upgrading the former Hongguang Electron Tube Factory; the construction stage introduced many cultural and creative enterprises and projects to form a relatively complete industrial chain; the operation stage improved its popularity and influence by organizing various cultural activities and building unique brands. With the acceleration of urbanization in China and the increasing demand for cultural consumption, popular science bases of industrial heritage type have undergone organic micro-renovations while preserving the original industrial sites, and at the same time, have planned four major functional industries dominated by leisure and entertainment, business offices, and artistic creativity, including creative parks, fashionable shopping areas, catering and entertainment areas, etc. Among them, Dongjiao Memory's creative park has special places such as Chengdu Intangible Cultural Heritage Museum and Dongjiao Memory Creative Market. Based on the reconstruction of the site, this type of popular science base first focuses on the integration with modern culture. Most of them have preserved the characteristics of industrial buildings from the planned economy era while transforming various complex factory buildings into commercial buildings. For example, workshops with large volumes and higher floor heights have been transformed into cinemas and theaters; unique areas enclosed by chimneys, conveyor belts, boilers, and other large structures have been designed as industrial-style music bar areas; old office buildings have been transformed into boutique hotels, etc. Second is the integration and innovation of the industrial chain. For example, by introducing core enterprises in the music industry chain, such as China Mobile Wireless Music Base and China Film Group, they have created a wireless music club base to attract other upstream and downstream enterprises to settle in and form a benign consumption interaction. At the same time, a science and technology cultural and creative incubation platform has been established to provide venues, funds, and technical support for startups. In addition, the park can further enrich its business forms by self-building, introducing dramas, films, and distribution services. Third is the planning of cultural activities and brand building. Regularly organizing various cultural activities, such as music festivals, art exhibitions, and design weeks, has increased the park's popularity and influence. At the same time, by building unique brands, such as "Creative Market" and "Chengdu Stage," it has further enhanced the park's cultural attractiveness. In addition, public charity market activities can also be held, attracting many volunteers and social organizations to participate and spread the spirit of public welfare.

2.3 Integration of Education and Popular Science

Many popular science bases also actively collaborate with schools and educational institutions to conduct study tours, popular science lectures, and other activities, integrating popular science into the education system and enhancing the scientific literacy of teenagers. Take Chengdu Sanhe Classic Car Museum and Lichao Aviation Museum as examples. These two museums share similarities in nature, both established on the basis of enterprise development. This type of museum adopts a combination of static displays and dynamic experiences, allowing visitors to more intuitively feel the charm of industrial artifacts such as classic cars and aircraft. For instance, in the static exhibition area, vehicles are displayed by era and brand; while in the dynamic experience area, classic car test drive activities are held regularly, enhancing

interactivity. Additionally, the museums focus on popular science education, offering automobile knowledge lectures and hands-on craft courses for teenagers to help them understand the structure and principles of automobiles. These initiatives not only enrich visitors' experiences but also contribute to the inheritance and development of automotive culture.

National and local governments have provided certain policy support and funding assistance for the construction of this type of popular science base. As a provincial and municipal popular science base, Lichao Aviation Museum also benefits from relevant preferential policies. However, due to factors such as policy enforcement and fund allocation, these policies provide limited practical support to Lichao Aviation Museum. Firstly, high ticket prices limit visitor numbers: The relatively high ticket prices at Lichao Aviation Museum are mainly due to high costs, maintenance fees, rent, and location. This to some extent restricts the number of visitors and affects the outreach of popular science education. Secondly, insufficient integration of popular science education resources: Although Lichao Aviation Museum possesses abundant physical exhibits and training equipment, there are still deficiencies in the integration and utilization of popular science education resources. For example, the depth and breadth of cooperation with partner units such as Ya'an Vocational and Technical College need to be strengthened. Thirdly, inadequate promotional efforts: Lichao Aviation Museum still lacks sufficient promotional efforts, resulting in limited public awareness and affecting its popularity and influence.

3. Issues and Challenges in the Integration Model

In actual operations, industrial culture popular science bases face numerous challenges, severely impacting the fulfillment of their popular science functions and the enhancement of their social influence.

3.1 Updating and Maintenance of Popular Science Facilities

With the rapid development of technology, exhibits related to "industrial culture" are updated quickly, making the issues of aging and outdated exhibits more prominent. The exhibition and education forms are also somewhat monotonous, exhibiting homogenization, lacking distinctive features and competitiveness, and struggling to meet the audience's ever-growing popular science needs. Updating exhibits requires substantial financial investment and technical support, yet most popular science bases have limited funding sources and struggle to promptly conduct large-scale updates and upgrades to exhibits. Currently, the primary funding sources for "industrial culture" popular science bases are still government grants, with social donations and self-operated income being relatively low. Insufficient funds restrict the development of popular science bases, impacting areas such as exhibit updating, popular science activities, and talent recruitment, necessitating further expansion of funding sources and improvement of self-sustaining capabilities. Compared to internationally advanced science museums, there is still a gap in popular science education concepts, exhibition forms, operational management, and other aspects. Popular science bases need to further innovate their operational models, strengthen cooperation with various social entities, and enhance their competitiveness and influence.

3.2 Sources and Stability of Funding for Popular Science

Taking the Shu Brocade Weaving Technique Inheritance Workshop in Qingyang District, Chengdu, as an example, this workshop, as a small industrial culture popular science base, mainly relies on government funding to maintain its operations. However, due to the single funding source and limited grant amounts, the workshop faces severe constraints in expansion, equipment updating, and talent training. According to the workshop's leader, due to insufficient funds, the exhibition equipment in the workshop has not been updated for years and still uses traditional methods of physical displays and graphic exhibition boards, lacking modern interactive technologies such as Virtual Reality (VR) and Augmented Reality (AR). Statistics show that the workshop's tourist growth rate over the past three years has only been 5%, far below the industry average, reflecting to some extent the inadequacy of its popular science experience. Based on survey data from popular science bases nationwide, approximately 30% of popular science bases face funding shortages, with small industrial culture popular science bases experiencing particularly prominent funding gaps.

3.3 Depth and Form of Popular Science Integration

Taking the Steel Industry Tourism Route in Jiulongpo District, Chongqing, as an example, although this route connects multiple popular science bases and surrounding attractions, visitor feedback indicates a lack of in-depth integration and innovative design, resulting in a relatively monotonous visitor experience. Furthermore, several industrial museums on this route have similar exhibition layouts and techniques, lacking individuality and innovation. Survey data shows that visitor satisfaction with this route is only 60%, far below the industry average. Based on survey data from industrial tourism routes nationwide, approximately 40% of routes suffer from issues of insufficient integration depth and monotonous forms. Although most industrial culture popular science bases have attempted to develop cultural and creative products, the design, production, and sales processes have failed to effectively connect with local cultural and creative industries, limiting the market competitiveness of these products. According to survey data on cultural and creative products from popular science bases nationwide, approximately 50% of popular science bases have obvious shortcomings in developing these products, with limited market competitiveness and cultural dissemination capabilities. Sales of cultural and creative products only account for 5% of the total annual income, far below the industry average. Taking the Science and Technology Museum in Jiang'an District, Wuhan, as an example, this museum overly emphasizes professionalism in the planning of popular science activities, neglecting fun and accessibility, leading to poor Popular Science effectiveness. Survey data indicates that participation in popular science activities at this museum is only 30%, far below the industry average. In addition, the museum's promotional channels are limited, mainly relying on traditional media and offline methods, failing to fully leverage the internet and new media for comprehensive and continuous promotion. Based on survey data from popular science bases nationwide, approximately 60% of popular science bases lack innovation and attractiveness in their popular science activities, have limited promotional channels, and have weak brand building awareness.

Popular science bases face significant issues in areas such as funding, integration depth, the excavation and utilization of industrial culture resources, and the innovation and attractiveness of popular science activities. To enhance the popular science functions and social influence of popular science bases, the efforts of governments, enterprises, and all sectors of society are required. Firstly, optimize the policy environment. It is recommended that governments increase policy support and funding assistance for the construction of popular science bases, particularly providing key support to popular science bases with significant development potential such as Lichao Aviation Museum. Meanwhile, strengthen policy enforcement and the construction of regulatory mechanisms to ensure the effective implementation of policies. Secondly, guide social participation. Encourage and support enterprises, social organizations, individuals, and other sectors of society to actively participate in the construction of popular science bases. By establishing partnerships and conducting joint popular science activities, strengthen cooperation and exchanges with various sectors of society to jointly promote the development of popular science undertakings. Thirdly, promote technological innovation, increase investment in innovation, enhance enterprises' innovation capabilities, encourage original and differentiated development, fully leverage modern technological means and innovative ideas, and strengthen the integration and utilization of popular science education resources. For example, enhance visitor experience and educational effectiveness by introducing advanced technological means such as intelligent guide systems and virtual reality technology; promote innovative development in popular science education by collaborating with universities, scientific research institutions, and other entities to conduct popular science research and innovation activities. Fourthly, raise public awareness. Strengthen the promotion and dissemination of popular science to enhance public recognition and emphasis on popular science education. Expand the coverage and influence of popular science education by conducting diverse popular science promotional activities, hosting popular science lectures and exhibitions, etc.; simultaneously strengthen cooperation and exchanges with media to increase the popularity and influence of popular science education. Utilize social media platforms (such as Douyin and Xiaohongshu) to publish engaging content to attract the attention of younger demographics, while also hosting thematic activities such as classic car parades and photography contests to enhance public participation. Fifthly, establish a long-term mechanism to deepen the integration of the "industrial culture+" perspective and explore more innovative models and development paths. Establish and improve a long-term mechanism and management system for the construction of popular science bases. Strengthen the overall planning of the popular science industry, avoid industrial homogenization, and create distinctive industrial chains; promote the standardized, institutionalized, and long-term development of popular science base construction by formulating scientific and reasonable development plans and implementation plans, strengthening personnel training and management, and other means.

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