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Construction of a Digital Resource Library for the Sustainable Inheritance and Educational Communication of Traditional Chinese Silk Craftsmanship

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Abstract: China, the country of origin of silk, boasts a substantial number of traditional silk techniques and silk-related intangible cultural heritage items. However, as time progresses and the economy expands, the development and inheritance of traditional silk craftsmanship have encountered difficulties. It is proposed that the construction of a digital resource library of Chinese silk craftsmanship would facilitate the resolution of the existing difficulties and the promotion of the educational communication of silk craftsmanship. Taking the construction of the digital resource library as an example, the paper introduces the technical requirements of the library's operating platform and the framework structure of its sharing platform. It also discusses the construction ideas and approaches employed in the construction of this resource library. Over a period of four years, in accordance with the principles of "joint construction, shared benefits and utilizing while constructing", a preliminary digital resource library of Chinese silk craftsmanship was established, with 11,186 granular materials completed, 24 standardized courses and skill training courses developed, and an online VR pavilion, "Chinese Silk Culture Museum", built. These have promoted the sustainable inheritance and educational communication of Chinese silk craftsmanship.

1. Introduction

The protection of intangible cultural heritage (ICH) emerged in the 21st century as a UNESCO endeavor committed to safeguarding the overall value and long-term interests of humanity by preserving the diversity of world cultures. The adoption of the Convention for the Safeguarding of the Intangible Cultural Heritage in 2003 marked a new stage in UNESCO-led and globally participated efforts to protect ICH[1]. As a major resource country for ICH, China has been an active participant in this endeavor. In 2004, China became one of the first countries in the world to accede

to the Convention for the Safeguarding of the Intangible Cultural Heritage[2]. Over the past two decades, China has demonstrated a consistent commitment to the principles of the Convention and conducted fruitful work in accordance with these principles, thereby making ICH protection a highlight of its cultural development endeavors. As of December 2023, a total of 730 heritage projects from 145 countries were included in the UNESCO Intangible Cultural Heritage Lists, with 43 from China.

China is believed to be the country in which silk was first produced. The practices of mulberry planting, silkworm breeding and silk weaving in China can be traced back 5,000 to 6,000 years[3]. Currently, two of China's traditional silk techniques are inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity: craftsmanship of Nanjing Yunjin brocade and sericulture and silk craftsmanship of China. Additionally, the Archives of Suzhou Silk from Modern and Contemporary Times is included on the Memory of the World Register. Of the five batches of national ICH projects (extensions included) that have been publicly announced, 23 projects related to silk have been identified, including 12 in the category of traditional techniques and 11 in the category of traditional fine arts. The traditional techniques include Yunjin brocade, Song brocade, Shu brocade, Kesi tapestry and cheongsam, and the traditional fine arts include Suzhou embroidery and Hunan embroidery. Furthermore, a plethora of provincial, municipal and district-level ICH projects associated with silk have been established.

The first batch of China's National List of Revitalization of Traditional Craftsmanship encompasses 283 items, of which 81 are related to textile spinning, dyeing, weaving and embroidering. These include the Song brocade weaving technique, the Sichuan brocade weaving technique, the Suzhou Kesi tapestry weaving technique and numerous other silk techniques.

Unfortunately, the acceleration of urbanization and modernization is rendering it increasingly challenging for the silk-related intangible cultural heritage to gain a foothold in contemporary society due to its "intangible" nature. And even worse, there is a risk of its gradual disappearance[4].

The inheritance of traditional Chinese silk craftsmanship has been impeded by a number of challenges encountered during the course of social and economic development[5]. In recent years, the silk industry has experienced a gradual decline, which can be attributed to several key factors.

(1) Its continued reliance on traditional handmade production methods, characterized by a lengthy production cycle, low efficiency and high costs, often fail to meet the demands of contemporary market.

(2) Many ICH projects are confronted with the challenge of an ageing inheritor population, with some even facing the absence of inheritors. This has limited the inheritance, innovation and development of the projects.

(3) Some ICH techniques are difficult and time-consuming to learn, and furthermore, disconnected from modern life. This results in a reluctance among younger individuals to engage with such projects.

(4) The traditional mode of inheritance is primarily founded upon the principles of closed inheritance such as master-disciple, family and workshop inheritance. This mode of inheritance is inherently flawed due to its closed nature, lengthy production cycle and limited educated audience. In this mode, the inferior cultural literacy of both teachers and learners, the weak innovation ability of inheritors and the difficulties inherent to the traditional oral and manual teaching approach, including the problems of collecting and preserving materials, combine to hinder the faithful transmission of traditional craftsmanship from generation to generation.

In conclusion, the sustainable inheritance and development of traditional Chinese silk craftsmanship are confronted with considerable challenges, including difficulties in learning, low productivity and the serious ageing of inheritors. It is therefore imperative to address these challenges in order to ensure the better inheritance, innovation and development of traditional silk craftsmanship.

With the advent of the digital revolution brought about by the Internet, there has been a gradual

consensus among countries around the world that ICH should be safeguarded, inherited and promoted through digital means in the information age. In the present era and in the future, digitalization represents a principal means of safeguarding and promoting ICH. For instance, the StoryCorps project of the United States exemplifies a strategy for the inheritance and protection of intangible cultural heritage. This is achieved through the comprehensive collection of audio and video recordings of the ICH bearers[6]. In South Korea, Jultagi is exhibited through virtual reality, whereby users are able to experience the acrobatic performance through the use of a head-mounted display (HMD). The utilization of digital technology provides an immersive and exhilarating experience for the users, as if they were walking a tightrope[7].

Currently, digital museums and databases represent the operational forms of ICH digitalization. In China, Suzhou Art & Design Technology Institute has spearheaded the development of a digital resource library, "Record of Hundreds of Arts and Crafts", to digitally record traditional ICH craftsmanship[8]. Yu Lan has introduced the utilization of digital technology for the construction of a comprehensive database of traditional patterns and crafts, which aims to facilitate the inheritance and innovative design of the weaving technique and patterns of Wu Leno, a silk-related ICH item[9]. By deeply integrating information technology, digital technology and artistic techniques, we can enhance the preservation, inheritance, promotion and innovation of intangible cultural heritage.

China has undertaken a substantial amount of work pertaining to the digital preservation, inheritance and promotion of intangible cultural heritage. Additionally, numerous reports have been published on the digital preservation of traditional silk craftsmanship and ICH projects. Nevertheless, these efforts tended to concentrate on specific techniques, and lacked a comprehensive approach to digital protection and inheritance.

This paper presents a discussion of the digital transformation and virtual display of traditional silk techniques and ICH project materials. This transformation involves the combination of digital technology and traditional craftsmanship and the construction of a comprehensive and systematic digital resource library of Chinese silk craftsmanship. This resource library serves as an autonomous learning platform, an educational platform and a platform for the promotion and application of traditional silk craftsmanship. The resource library can facilitate school students, members of the community and enterprise personnel in learning silk craftsmanship, thereby promoting its inheritance and dissemination.

2. Technical Support for the Resource Library Operating Platform

The resource library of traditional Chinese silk craftsmanship is a digital resource library created based on the Intelligent Connected Vocational Education (ICVE) of Higher Education Press. Launched in 2015, the ICVE platform integrates the features of major domestic and international learning platforms in order to meet the specific requirements of vocational education with the primary principle of being "learning-enabled and education-supportive". It adopts the MOOCs (Massive Open Online Courses) approach to create various courses[10].

The ICVE, as a sharing platform, supports the uploading and downloading of resources of diverse types and formats, including text, image, animation, video, audio and so forth. The resources can be automatically categorized, stored and previewed according to their filename extensions. The platform also offers a range of functionalities for the processing of resources, including the batch uploading, downloading, adding, converting and deleting of resources, their online editing, viewing and previewing, as well as the uploading of oversized attachments and continuous uploading from breakpoints. Furthermore, it is capable of performing intelligent compression and distribution of uploaded resources. It also supports the automatic identification, labelling and inheritance of attributes when uploading resources in batch.

In terms of framework design, the ICVE sharing platform is composed of a variety of teaching and learning resources at different levels, including a material center, a microlecture center, a module center, a course center and a professional garden (see Table 1 for details). It also has functions like intelligent push, online learning and multi-terminal adaptation, etc. The platform has been designed for different user groups, including student users, teacher users, enterprise users and social users, with the objective of facilitating the effective integration of sharing mechanisms and a sharing platform[11].

The framework structure of the ICVE sharing platform is illustrated in Figure. 1. The logical main line can be summarized in a bottom-up logic according to different levels of teaching and learning resources as follows: material – modular learning object/microlecture – module/project – course – profession. The specific descriptions are provided in Table 1.

Table 1: Teaching and Learning Resources of the Resource Library at Different Levels.

Project	Description
Material Center	A repository for fragmented resource materials, including text, image, animation, video, audio and PowerPoint presentation, etc.
Microlecture Center	Combines multiple related materials into modular learning objects based on knowledge and skill points.
Module Center	Groups multiple modular learning objects of knowledge and skill points, which are organized into work tasks and skill training projects.
Course Center	Comprises multiple work tasks and skill training projects, offering standardized and personalized courses.
Professional Garden	Aggregates multiple courses to showcase the overall profession, referring to the digital resource library of traditional Chinese silk craftsmanship in this paper.

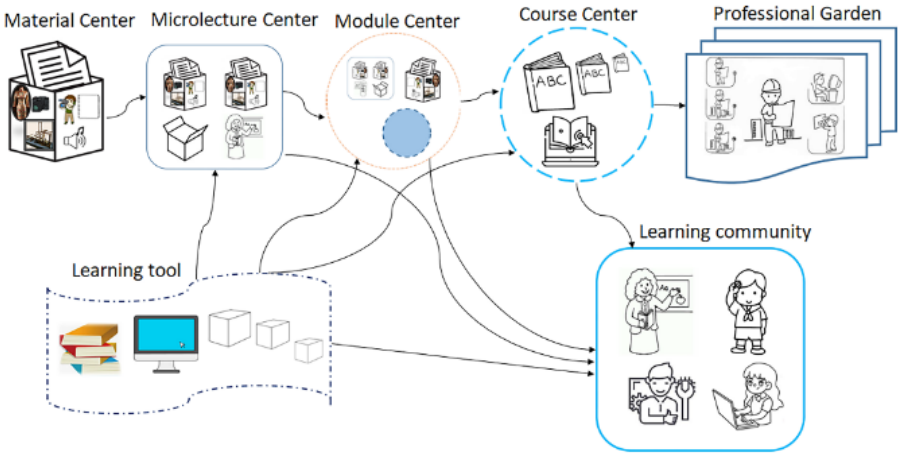

Figure 1: Framework Structure of the Sharing Platform of Resource Library.

The ICVE sharing platform has fundamental functions such as the construction, maintenance, management, teaching, learning and analysis of a resource library. The platform is operated based on user-centered approach, facilitating personalized learning and teaching. In order to enhance data access speed, the platform employs optimization technologies, including IDC (Internet Data Center), cache and CDN (Content Delivery Network), thereby ensuring rapid access to resources and efficient downloading. Moreover, it adheres to a stipulated high level of security in terms of physical security, network security, host security, application security, data security and management requirements.

3. Construction Approach for the Digital Resource Library

3.1 Overall Construction Strategy

The resource library of Chinese silk craftsmanship has been developed by Suzhou Institute of Trade & Commerce, Chengdu Textile College and Jiangsu College of Engineering and Technology, in collaboration with other colleges, universities and silk enterprises and public institutions, which collectively contribute to the development of resources. The design process of the overall construction is illustrated in Figure. 2. The developers of the resource library construct online knowledge systems comprising materials, microlectures and courses in accordance with defined standards and utilize the ICVE platform for the storage of the resources. The resource library is designed to cater to four user groups: student users, teacher users, enterprise users and social users[10].

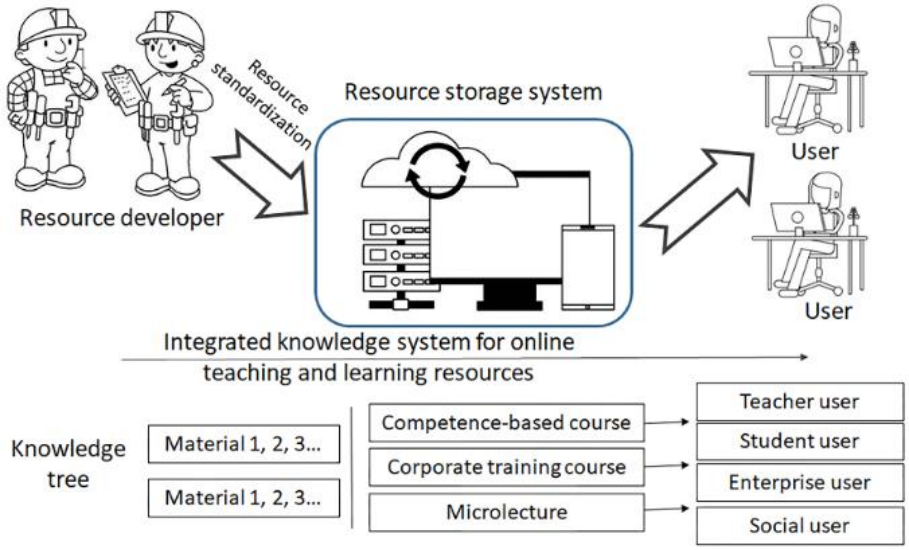

Figure 2: Design Process of the Overall Construction of the Resource Library.

3.2 Joint Contribution and Shared Sustainable Development and Application

An alliance with joint contribution and shared benefits has been established by the developers of the resource library, with the responsibilities, rights and interests of each alliance member clearly defined. As a consequence of the alliance's comprehensive integration of the high-quality teaching resources contributed by its members, and its collective development, construction, utilization and maintenance of these resources, an open-ended multifunctional teaching and service platform is formed, with the functions of teaching, training, case studies and so forth. By providing cross-school and cross-regional high-quality resources for students, teachers, enterprise users, social learners and other types of users, the platform facilitates the sharing, updating and continuous application of the resources.

A variety of measures have been implemented to optimize the resource library. For example, a system for the long-term promotion and application of the resources in the resource library has been devised with the objective of ensuring the continuous construction and updating of the resources. The requirements for the construction and application of a resource library were taken into account to ensure the sustainable development of the resource library of Chinese silk craftsmanship. Moreover, in accordance with the principles of "joint construction, shared benefits and utilizing while constructing", related courses were made available on the smart cloud. Additionally, a mechanism for the operation management and update maintenance of the resource library was created to ensure

the continuous updating of teaching resources in order to meet the needs of teaching activities and technological development, with a certain percentage of updates carried out on an annual basis.

3.3 Content Design

The resource library serves the purpose of disseminating information regarding intangible cultural heritage projects related to silk, as well as traditional techniques associated with the production of silk. Additionally, it should promote the knowledge related to the technology utilized in the production of silk, product innovation and design and others. On account of the development of traditional Chinese silk craftsmanship, the status quo of silk-related intangible cultural heritage and the requirements for educational communication, four core modules have been designed in the resource library: “Learning Garden”, “Cultural Garden”, “Innovation Garden” and “Training Center”. The content design is illustrated in Figure 3.

The “Learning Garden” functions as a resource learning platform, offering a range of courses, microlectures and materials (see Table 1 above). More than 20 standardized courses and skill training courses have been developed, which can be used by students and social members to learn the silk techniques.

The “Cultural Garden” is a knowledge extension platform, where an online VR pavilion “Chinese Silk Culture Museum” has been built. The museum showcases the various aspects of silk culture over the span of thousands of years, especially the long history and cultural significance of silk, traditional silk techniques and innovation of modern silk products, etc. In this module, users can deepen their knowledge of Chinese silk craftsmanship and learn about literary allusions, poems and folklore of silk.

The “Innovation Garden” is a service innovation platform comprised of three sub-modules: “Industry Innovation”, “Silk Standards” and “Innovation and Entrepreneurship Center”. This module offers a timely overview of the latest news, concepts and products of the silk industry.

The “Training Center” is a skill training platform that provides skill training programs and “New Silk Road College” international cooperation program. Its objective is to provide technical skill training for users in the business community, civil society and the student population. In collaboration with enterprises engaged in the silk industry, this platform develops training resources and courses for vocational skills level certification in accordance with relevant standards.

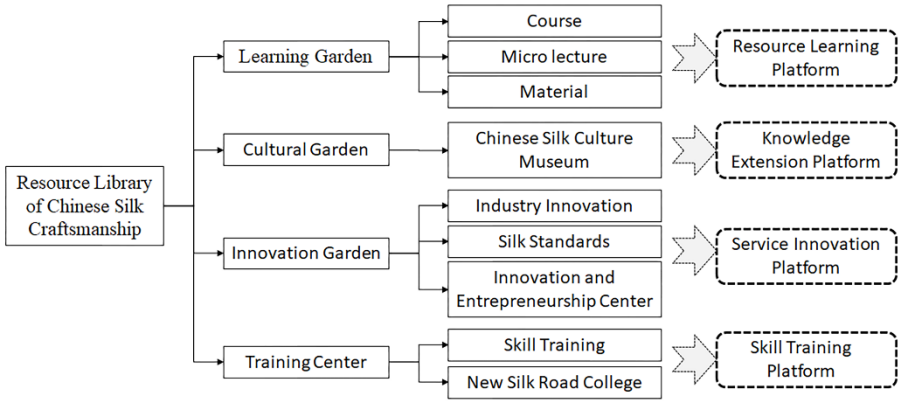

Figure 3: Content Design of the Resource Library.

4. Construction and Application of Resource Library of Chinese Silk Craftsmanship

Over the course of four years, in addition to the leading role of Suzhou Institute of Trade & Commerce, Chengdu Textile College and Jiangsu College of Engineering and Technology, as well

as the joint contribution of nine colleges and universities and fifteen silk enterprises and public institutions, more than ten inheritors of the silk-related intangible cultural heritage have also actively participated in the construction of the resource library of Chinese silk craftsmanship. The homepage of the resource library website is presented in Figure 4.

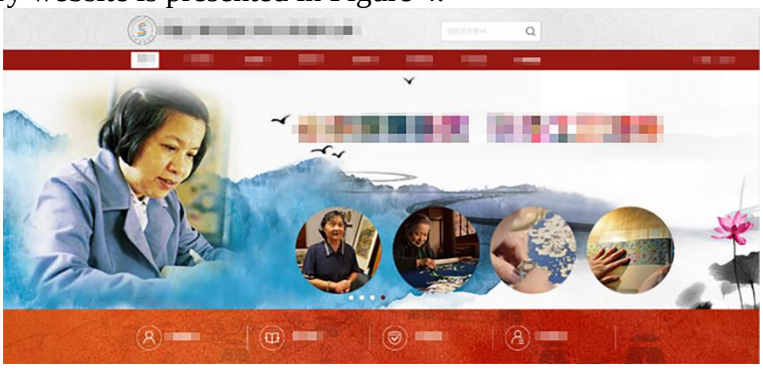

Figure 4: Website of the Resource Library of Chinese Silk Craftsmanship.

4.1 Construction of Microlectures and Materials

In accordance with the content design plan for the construction of the resource library and the demand for the creation of resource materials, as well as the requirements of the teaching resources, a variety of granular resources have been developed. These include microlectures, videos, pictures, texts, audios, animations and other materials about the traditional silk techniques, the introduction to the inheritors, the professional knowledge of silk, as well as the teaching standards and courseware, etc. A resource material center was formed as a result of the systematic design and construction of these granular resources. The granular resources, comprising 11,186 items, have been completed, with a total storage capacity exceeding 802GB. This encompasses 5,092 video materials, 206 audio materials, 107 virtual simulation materials, 83 animation materials and 137 other non-textual media materials (Figure 5).

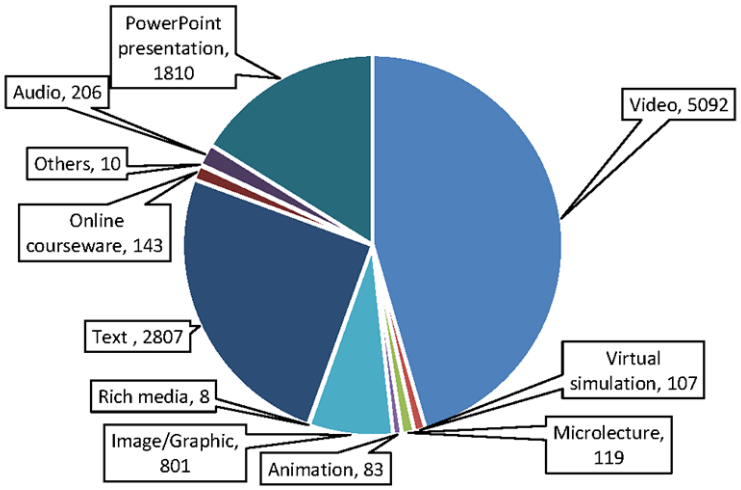

Figure 5: Numbers of Materials of Each Type in the Resource Library.

In addition, 696 microlectures have been developed. By integrating a range of information technology tools, the microlectures present and analyze knowledge points in a progressive manner through brief videos, PowerPoint presentations and other teaching materials. This approach is conducive to fostering learners' interest and deepening their understanding of the knowledge being presented.

4.2 Construction of Course Resources

A total of 24 standardized courses and skill training courses have been established in the "Learning Garden" and "Training Center". Of the 24 courses, those directly related to the silk-related ICH include *Famous Chinese Brocade*, *Traditional Techniques and Innovation of Cheongsam*, *Inheritance and Innovation of Leno Weaving Technique*, *Learn Kesi Tapestry with Me*, *Learn Shu Brocade with Me*, *Learn Embroidery with Me*, *Learn Blue Indigo Printing with Me* and other courses (Table 2), as well as the corresponding supplementary courses.

Table 2: The Course Directly Related to the Silk-related ICH.

Course	Intangible Cultural Heritage
Famous Chinese Brocade	Craftsmanship of Nanjing Yunjin brocade, Sericulture and silk craftsmanship of China (Shu brocades of Chengdu, Song brocades of Suzhou)
Traditional Techniques and Innovation of Cheongsam	Longfeng cheongsam handmade skills
Inheritance and Innovation of Leno Weaving Technique	Sericulture and silk craftsmanship of China (Hangzhou Leno), Weaving techniques of Wu Leno
Learn Kesi Tapestry with Me	Sericulture and silk craftsmanship of China (Kesi Tapestry)
Learn Shu Brocade with Me	Shu brocades of Chengdu
Learn Embroidery with Me	Su Embroidery
Learn Blue Indigo Printing with *Me*	Blue calico printing and dyeing technology

In the development of course resources, a tiered approach has been employed for the construction of both fundamental and extended course resources, which can assist learners in their autonomous learning according to different learning styles and learning paths. On the basis of the 24 core courses, resource applicants are able to upload personalized courses on the ICVE cloud and MOOC platform, taking into account the cultural characteristics of silk and the specific needs in different regions. According to incomplete statistics, 121 such courses have been made available on the ICVE cloud to date. The digitalization of the online resources has the effect of eliminating geographical constraints in learning. This characteristic has facilitated the expansion of high-quality resources for vocational colleges in both eastern and western regions through the creation of the personalized courses. This has contributed to the joint construction and sharing of vocational education resources, thereby advancing educational equity across diverse regions. And ultimately, the courses can facilitate greater access to silk craftsmanship for a larger number of people.

The construction of course resources has also received support from numerous inheritors of silk-related intangible cultural heritage, most notably including Qian Xiaoping, the representative inheritor of the national intangible cultural heritage of Song brocade weaving technique. Additionally, Yao Jianping and Gu Wenxia, the representative inheritors of Suzhou embroidery, He Bin, the representative inheritor of the Sichuan brocade weaving technique, Wang Jinshan, the representative inheritor of Kesi tapestry weaving technique, and Wang Chen, the representative inheritor of Zhangzhou satin weaving technique, among others, have offered support. Photographs of some of the inheritors are presented in Figure. 6. Their involvement has facilitated the preservation, inheritance, dissemination and intergenerational transmission of silk-related intangible cultural heritage projects, thereby fostering the growth of a new generation of potential inheritors.

Figure 6: Silk-related ICH Inheritors who Offered Support.

4.3 Construction of Online Cultural Museums

The "Cultural Garden" features an online VR pavilion "Chinese Silk Culture Museum" which provides an overview of silk culture over the span of thousands of years in various aspects (Fig. 7). The museum is comprised of three sub-museums: "Pavilion of Silk Whispers", "Workship of Silk Art" and "Hall of Silk Masters". The "Pavilion of Silk Whispers" presents an overview of the history of silk in China, including its origin and development. It also explores the cultural and linguistic elements associated with silk, such as legends, languages, archaeological evidence, silk costumes and the cultural significance of silk in Chinese history. The "Workshop of Silk Art" primarily showcases a variety of silk techniques, including Song brocade, Yunjin brocade, Sichuan brocade, Sichuan embroidery, Suzhou embroidery, Hunan embroidery, Guangdong embroidery and other representative traditional silk techniques and products. And the "Hall of Silk Masters" is primarily dedicated to the exhibition of information about a diverse array of figures associated with Chinese silk craftsmanship, including celebrities, skilled craftspersons and intangible cultural heritage inheritors.

Figure 7: Scenes from the Online Cultural Museums.

4.4 Dissemination and Application of Resource Materials

The total number of registered users of the resource library platform currently stands at 33,606, with a total of 403,251,015 user behavioral activities recorded. The platform's total storage capacity exceeds 802GB, with the total duration of video amounting to 22,468 minutes. The user population of the resource library is diverse, comprising teachers, students from vocational colleges and primary and secondary schools, enterprise users and social users, among others. Notably, students from the development organizations of the resource library and applied secondary and higher vocational colleges contribute to 94% of the learning activities. The digital resources available online have been developed with the objective of providing education, disseminating traditional silk craftsmanship and

facilitating the inheritance and development of silk cultural heritage. Figure 8 illustrates the utilization of the resource library material by a member of the development team for teaching purpose.

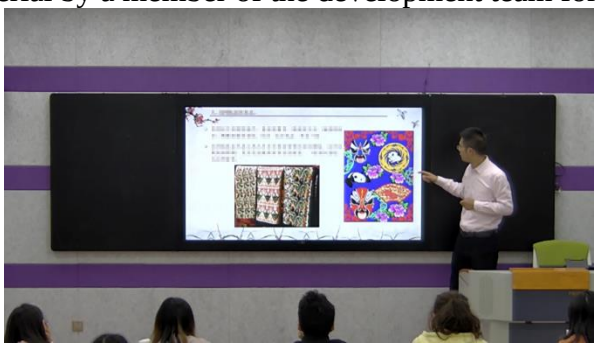

Figure 8: A Team Member Teaching with Online Digital Resources from the Resource Library.

Figure 9: Bilingual Textbooks on Intangible Cultural Heritage of Kesi Tapestry Weaving Technique.

Moreover, in order to respond to the Belt and Road Initiative, reinforce cultural exchanges at home and abroad, and facilitate greater international comprehension of traditional Chinese silk craftsmanship, ten bilingual textbooks are to be developed and published as supporting teaching materials to facilitate the international promotion and application of the resource library courses. Three out of ten textbooks have been published to date. Figure 9 above presents the bilingual textbooks on intangible cultural heritage of Kesi tapestry weaving technique.

5. Conclusion and Future Work

This study points out that the establishment of a digital resource library is conducive to addressing the difficulties in the inheritance of traditional Chinese silk craftsmanship and promoting its inheritance and educational communication. Taking the construction of the digital resource library of Chinese silk craftsmanship as an example, the paper introduces the technical requirements of the operating platform, on which the resource library is based, and the framework structure of its sharing platform. Furthermore, the paper explores the construction ideas of the digital resource library. Following a period of more than four years, a resource library of Chinese silk craftsmanship has been constructed in its initial phase. The construction of 11,186 granular resources has been completed, with a total storage capacity of more than 802GB of materials. These materials include 5,092 video materials, 206 audio materials, 107 virtual simulation materials, 83 animation materials, and 137 other non-textual media resource materials. Besides this, the resource library has developed 24 standardized courses and skill training courses, as well as an online VR pavilion “Chinese Silk Culture Museum”, with the objective of promoting the digital preservation, inheritance and educational communication

of Chinese silk craftsmanship.

However, the construction of the resource library of Chinese silk craftsmanship represents merely a phase of a larger undertaking, with numerous additional tasks yet to be completed. Firstly, it's imperative to conduct digital preservation on some traditional silk techniques that are currently being lost. Secondly, it is necessary to ensure that the resource materials are continuously updated and optimized in order to provide learners with the most up-to-date and effective materials. And lastly, further investment of time and financial resources is required to enhance the quality of the resource library.

The digital resource library of Chinese silk craftsmanship has addressed the issue of resource scarcity and the imbalance between supply and demand by sharing high-quality resources on the platform. This facilitates the formation of a comprehensive system for the inheritance and dissemination of silk craftsmanship. The system can operate in schools and other educational institutions, where it can help foster a larger pool of individuals with an interest in silk, who may potentially become the inheritors of silk craftsmanship. Furthermore, the resource library can facilitate the inheritance of silk craftsmanship from generation to generation, thereby ensuring the sustainable preservation, inheritance and dissemination of the silk-related intangible cultural heritage.

Acknowledgements

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