

MULTIMODAL KNOWLEDGE GRAPH OF CHINESE TRADITIONAL CRAFTS AND INTELLIGENT TEACHING RESOURCE LIBRARY

GRÁFICO DE CONHECIMENTO MULTIMODAL SOBRE ARTESANATO TRADICIONAL CHINÊS E BIBLIOTECA DE RECURSOS DIDÁTICOS INTELIGENTES

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Abstract

Chinese traditional crafts, a precious part of Chinese cultural heritage, face severe inheritance and teaching challenges in digital transformation: fragmented knowledge, scarce intelligent teaching resources, and backward teaching modes. To address these issues, this study constructs a multimodal knowledge graph (integrating text, image, audio, video) of Chinese traditional crafts and develops a matching intelligent teaching resource library, adopting qualitative and quantitative methods. Results show the knowledge graph effectively integrates scattered craft knowledge, while the resource library makes up for traditional teaching resource shortages and improves teaching efficiency. This study promotes innovative craft inheritance and provides a new technical path for integrating intelligent education with traditional cultural teaching.

Keywords: Multimodal Knowledge Graph. Chinese Traditional Crafts. Intelligent Teaching Resource Library. Digital Inheritance. Intelligent Education. Knowledge Construction.

Resumo

O artesanato tradicional chinês, uma parte preciosa do patrimônio cultural chinês, enfrenta sérios desafios de herança e ensino na transformação digital: conhecimento fragmentado, recursos de ensino inteligentes escassos e modos de ensino ultrapassados. Para abordar essas questões, este estudo constrói um gráfico de conhecimento multimodal (integrando texto, imagem, áudio e vídeo) do artesanato tradicional chinês e desenvolve uma biblioteca de recursos de ensino inteligentes correspondente, adotando métodos qualitativos e quantitativos. Os resultados mostram que o gráfico de conhecimento integra efetivamente o conhecimento disperso sobre artesanato, enquanto a biblioteca de recursos compensa a escassez de recursos de ensino tradicionais e melhora a eficiência do ensino. Este estudo promove a herança inovadora do artesanato e fornece um novo caminho técnico para integrar a educação inteligente ao ensino da cultura tradicional.

Palavras-chave: Gráfico de Conhecimento Multimodal. Artesanato Tradicional Chinês. Biblioteca de Recursos de Ensino Inteligentes. Herança Digital. Educação Inteligente. Construção de Conhecimento.



1 INTRODUCTION

1.1 Research background

Chinese traditional crafts, with a history of thousands of years of inheritance and development, are the crystallization of the labor wisdom and cultural creativity of the Chinese nation. They carry the unique cultural genes and spiritual connotations of the Chinese nation, serving as important carriers of Chinese cultural soft power and an indispensable part of world cultural heritage (Li, J., Wang, H., & Zhang, L., 2022). Typical crafts such as Qiang embroidery, Yi lacquerware, Tibetan weaving, Longquan celadon, and jade carving have witnessed historical changes and recorded national cultural memories. For instance, Qiang embroidery, listed in the first batch of national intangible cultural heritage in 2006, integrates Qiang history, customs and beliefs, while Yi lacquerware, with a 2,000-year inheritance, reflects the Yi people's unique artistic pursuit.

However, in the context of rapid modernization, urbanization and digitalization, Chinese traditional crafts are facing unprecedented inheritance dilemmas, with the shortage of intelligent teaching resources becoming a key bottleneck, seriously restricting their survival and development. The specific problems are mainly reflected in two aspects:

On the one hand, the digital inheritance of traditional crafts is in dilemma. First, craft knowledge is fragmented and easily lost. Most craft knowledge is inherited through the "mentor-apprentice" mode, relying on oral teaching and hands-on demonstration, lacking systematic digital records. A large number of unique techniques and experiences are only mastered by a few elderly inheritors, leading to irreversible loss and "inheritance fault" (Wang, Y., & Zhang, Q., 2021). Second, digitalization is incomplete and single-modal. Existing digital resources are mostly limited to text and images, lacking integration of audio (operation sounds, inheritor explanations) and video (production processes, demonstrations), failing to reflect the operability of crafts and making it difficult for learners to grasp core skills. Third, digital resources are scattered as "information islands" in documents, websites, museums and individual inheritors, without effective integration, hindering efficient dissemination.

On the other hand, intelligent teaching resources for crafts are scarce. First, existing resources are backward and low in intelligence, mostly simple text, images or single videos, lacking knowledge association, personalized recommendation and interactive functions, only realizing one-way knowledge dissemination (Zhao, L., Chen, J., & Liu, H., 2021). Second, resources are unsystematic and unstandardized, making it difficult for teachers to conduct standardized teaching and learners to form a complete knowledge system. Third, the integration of resources and intelligent technologies (artificial intelligence, big data, virtual reality) is inadequate, failing to provide personalized guidance, intelligent evaluation and immersive experience, affecting teaching and learning efficiency.

In recent years, the Chinese government has issued policies such as the "14th Five-Year Plan for the Protection and Inheritance of Intangible Cultural Heritage" and the "National Medium and Long-Term Education Reform and Development Plan (2021-2035)", supporting the digital inheritance of crafts and the development of intelligent teaching resources. Meanwhile, digital technologies such as multimodal information processing and knowledge graph provide new solutions (Zhang, H., Li, M., & Wang, Z., 2022).

Multimodal knowledge graph integrates text, image, audio and video information, forming a structured knowledge network with entities as nodes and relationships as edges, which can effectively solve the fragmentation and single-modal problems of craft knowledge (Li, C., Zhang, B., & Liu, J., 2023). It has been widely applied in cultural heritage protection and intelligent education, but few studies focus on its application in Chinese traditional crafts, especially the integration with intelligent teaching resource libraries. Most existing studies focus on single-modal digitalization or simple knowledge graphs, failing to meet the needs of systematic inheritance and intelligent teaching. Therefore, constructing a multimodal knowledge graph and matching intelligent teaching resource library is urgent and practically significant.

1.2 Research purpose

Aiming at the digital inheritance dilemma and shortage of intelligent teaching resources of Chinese traditional crafts, this study clarifies the following core research purposes:

First, construct a scientific and standardized multimodal knowledge graph of Chinese traditional crafts. Taking typical crafts (Qiang embroidery, Yi lacquerware, Tibetan weaving) as objects, integrate multi-dimensional information to solve the fragmentation and scattering of craft knowledge, realize systematic organization, standardized expression and visual display, and provide a structured knowledge base for digital inheritance.

Second, develop an intelligent teaching resource library matching the multimodal knowledge graph. Integrate intelligent education technologies based on the constructed knowledge graph to provide personalized resources, interactive experience and intelligent guidance, making up for the shortage of traditional teaching resources and meeting the needs of modern intelligent teaching.

Third, verify the effectiveness and practicality of the constructed knowledge graph and resource library through empirical research, ensuring that the results can effectively solve existing problems and support digital inheritance and intelligent teaching.

Fourth, summarize research achievements, clarify theoretical and practical value, analyze deficiencies and put forward feasible prospects, providing reference for follow-up research and promoting long-term development of craft inheritance and intelligent education.

1.3 Research significance

This study has important theoretical and practical significance for promoting the innovative inheritance of Chinese traditional crafts and improving the level of intelligent education.

1.3.1 Theoretical significance

First, it enriches the application of multimodal knowledge graph in traditional crafts. Existing research focuses on cultural relics, medical care and other fields, while this study explores the construction method suitable for crafts, expanding its application scope in cultural heritage.

Second, it improves the theoretical system of digital inheritance of crafts. By constructing a multimodal knowledge graph, it solves the fragmentation problem, enriches theoretical methods of digital inheritance.

Third, it promotes the integration of traditional cultural teaching and intelligent education theory. It explores the integration mode of knowledge graph and intelligent teaching resource library, providing a new theoretical perspective for their integration.

Fourth, it enriches the research content of digital humanities, using digital technologies to study traditional crafts and promoting the development of digital humanities in this field.

1.3.2 Practical significance

First, it provides a new technical path for digital inheritance. The knowledge graph realizes systematic organization and visualization of craft knowledge, facilitating preservation and dissemination, and helping avoid knowledge loss.

Second, it makes up for the shortage of intelligent teaching resources. The resource library, with personalized recommendation and interactive functions, improves learning enthusiasm and teaching effect, providing standardized resources for teachers.

Third, it promotes innovative inheritance and cultivates young inheritors, breaking the "mentor-apprentice" limitation and solving the "inheritance fault" problem.

Fourth, it promotes the integration of traditional culture and education, enhancing national cultural confidence and improving the level of intelligent education.

Fifth, it provides decision-making reference for cultural and educational departments, supporting the formulation of scientific policies for craft inheritance and intelligent education.

1.4 Research contente

Focusing on "multimodal knowledge graph construction" and "intelligent teaching resource library development", the research content is divided into four core parts.

1.4.1 Construction of multimodal knowledge graph of Chinese traditional crafts

First, determine the scope (typical crafts including Qiang embroidery, Yi lacquerware, Tibetan weaving) and design principles (completeness, accuracy, practicality) of the knowledge graph, and construct its overall framework (entity layer, relationship layer, attribute layer, multimodal information layer). Second, complete four key links: multimodal data collection (text, image, audio, video) and processing (cleaning, standardization, annotation). knowledge extraction (entities, relationships, attributes) using NLP, image and audio recognition. knowledge representation (RDF, OWL) and fusion (solving heterogeneity and conflicts). knowledge reasoning and quality evaluation (completeness, accuracy, consistency).

1.4.2 Development of intelligent teaching resource library based on multimodal knowledge graph

First, clarify the design objectives (meet intelligent teaching needs, improve efficiency) and principles (user-centered, systematic), and construct the overall architecture (data layer, knowledge layer, application layer, interface layer) and functional modules (knowledge query, resource display, personalized recommendation, learning evaluation, management). Second, complete database design (knowledge graph, teaching resource, user, learning record databases), resource integration (associating knowledge graph with teaching resources), and system development (using Python, Vue.js, MySQL to develop a stable prototype system).

1.4.3 Empirical verification of research results

Select students, teachers and inheritors from relevant colleges and universities as experimental objects, divide them into experimental group (using the constructed knowledge graph and resource library) and control group (using traditional teaching mode). Collect experimental data (knowledge scores, learning time, satisfaction) within 16 weeks, and analyze the data with SPSS and qualitative methods to verify effectiveness.

1.4.4 Summary of results and research prospects

Summarize core achievements, analyze deficiencies (limited knowledge graph scope, insufficient resource library intelligence, short experimental cycle), and put forward prospects (expand knowledge graph scope, optimize intelligent functions, strengthen long-term empirical research).

1.5 Research methods

Combining qualitative and quantitative research, this study adopts the following core methods.

1.5.1 Multimodal data collection and processing method

Collect multi-dimensional data through field investigation, literature retrieval and network crawling. preprocess data through cleaning, standardization, segmentation, annotation and integration to ensure data quality, laying the foundation for knowledge graph construction.

1.5.2 Knowledge graph construction technology

Adopt knowledge extraction (NLP, image/audio recognition), knowledge representation (RDF, OWL), knowledge fusion (multi-source fusion to solve conflicts)

and knowledge reasoning (rule reasoning + machine learning) technologies to construct the multimodal knowledge graph.

1.5.3 Intelligent teaching resource development technology

Use database design (MySQL, Neo4j), resource integration (associating knowledge graph with teaching resources) and system development (front-end and back-end separation) technologies to develop the intelligent teaching resource library prototype system.

1.5.4 Supplementary research methods

Literature research method (sorting out relevant theories and research status), field investigation method (collecting first-hand data in craft inheritance areas), experimental verification method (empirical research to verify effectiveness), and quantitative and qualitative analysis method (analyzing experimental data comprehensively).

1.6 Innovation points

Compared with existing research, the innovation points are as follows:

First, research perspective innovation: combining multimodal knowledge graph with craft digital inheritance and intelligent teaching, realizing systematic organization of multi-dimensional craft knowledge and providing a new research idea.

Second, integration mode innovation: taking multimodal knowledge graph as the core of the resource library, realizing intelligent association and recommendation of teaching resources, solving the scattered problem of traditional resources.

Third, application practice innovation: taking typical crafts as objects, constructing practical knowledge graph and resource library, verifying effectiveness through empirical research, and providing feasible technical schemes for craft inheritance and teaching.

2 THEORETICAL BASIS AND RELATED TECHNOLOGY

This chapter clarifies the theoretical basis and related technologies, laying a foundation for subsequent research.

2.1 Theoretical basis

2.1.1 Knowledge graph theory,

Proposed by Google in 2012, knowledge graph is a structured knowledge organization method with entities as nodes and relationships as edges (Singhal, A., 2012). Divided into single-modal (text-based) and multimodal (integrating text, image, audio, video) types, the latter can more comprehensively express knowledge connotation (Liu, Z., Li, Y., & Wang, X., 2022). Its core elements include entities (craft categories, techniques, inheritors, etc.), relationships ("has", "belongs to", etc.) and attributes (pattern color, inheritor age, etc.). The construction process includes knowledge extraction, representation, fusion and reasoning, providing a theoretical basis for systematic organization of craft knowledge (Li, C., Zhang, B., & Liu, J., 2023).

2.1.2 Multimodal information processing theory

A cross-disciplinary theory studying the collection, processing, fusion and application of multi-modal information (Zhang, Y., Liu, M., & Li, Z., 2021). Multi-modal information refers to information in different forms (text, image, audio, video), and its processing includes data preprocessing, feature extraction and fusion. This theory provides a theoretical basis for integrating multi-dimensional craft information and constructing the multimodal knowledge graph.

2.1.3 Intelligent education theory

Focusing on the integration of intelligent technologies and education, intelligent education theory emphasizes personalized learning, interactive teaching and intelligent

evaluation. It provides a theoretical basis for the development of the intelligent teaching resource library, guiding the design of personalized recommendation and interactive learning modules.

2.1.4 Cultural heritage digital inheritance theory

This theory advocates using digital technologies to realize the preservation, dissemination and inheritance of cultural heritage. It provides a theoretical basis for applying multimodal knowledge graph and intelligent technologies to solve the digital inheritance dilemma of traditional crafts.

2.2 Related technology

2.2.1 Multimodal data processing technology

Including text processing (segmentation, annotation), image processing (recognition, feature extraction), audio processing (noise reduction, recognition) and video processing (segmentation, action recognition), ensuring the effective processing of multi-dimensional craft data.

2.2.2 Knowledge graph construction technology

Including knowledge extraction technology (NLP, image/audio recognition), knowledge representation technology (RDF, OWL), knowledge fusion technology (multi-source knowledge fusion) and knowledge reasoning technology (rule reasoning, machine learning reasoning), supporting the construction of high-quality multimodal knowledge graph.

2.2.3 Intelligent teaching resource development technology

Including database technology (MySQL, Neo4j), front-end development technology (Vue.js, Element UI), back-end development technology (Python, Java) and

intelligent recommendation technology (collaborative filtering, content-based recommendation), supporting the development of the intelligent teaching resource library.

3 CONSTRUCTION OF MULTIMODAL KNOWLEDGE GRAPH OF CHINESE TRADITIONAL CRAFTS

3.1 Basic framework design of the knowledge graph

Taking Qiang embroidery, Yi lacquerware and Tibetan weaving as core objects, the knowledge graph covers craft categories, techniques, inheritors, works, materials and cultural connotations, following the principles of completeness, accuracy, practicality and extensibility. Its overall framework includes four layers:

1. Entity layer: Core entities such as "Qiang embroidery", "embroidery technique", "He Youzhi" (Qiang embroidery inheritor), and "Flower and Bird Pattern" (Qiang embroidery work).
2. Relationship layer: Semantic relationships between entities, such as "Qiang embroidery has pattern", "embroidery technique is mastered by He Youzhi".
3. Attribute layer: Attributes of entities, such as "Qiang embroidery pattern color: bright red", "He Youzhi age: 65".
4. Multimodal information layer: Multi-dimensional information associated with entities, such as pattern images, operation videos and inheritor explanation audio.

3.2 Multimodal data collection and processing

3.2.1 Data collection

Through field investigation (Aba Tibetan and Qiang Autonomous Prefecture, Liangshan Yi Autonomous Prefecture, Tibet Autonomous Region), literature retrieval and network crawling, multi-dimensional data are collected: text data (craft introduction, inheritor information), image data (patterns, works, operation scenes), audio data (operation sounds, explanations), video data (demonstrations, production processes).

3.2.2 Data processing

Data cleaning: Remove redundant, wrong and missing data. data standardization: Unify data format and naming rules. data segmentation: Segment text, audio and video into manageable units. data annotation: Annotate entities, relationships and modal information. data integration: Integrate multi-source data to form a unified data set.

3.3 Key technologies for knowledge graph construction

3.3.1 Knowledge extraction

Text knowledge extraction: Use NLP technology to extract entities, relationships and attributes from text data. Image knowledge extraction: Use image recognition technology to extract pattern attributes and entities from images (Li, S., Wang, J., & Zhang, H., 2022). Audio knowledge extraction: Use audio recognition technology to extract audio attributes and inheritor explanations. Video knowledge extraction: Use video analysis technology to extract dynamic entities and operation relationships (Li, Z., Wang, H., & Chen, J., 2023).

3.3.2 Knowledge representation

Use RDF and OWL to standardize the extracted knowledge, realizing machine-understandable. For example, the triple "Qiang embroidery - has - Flower and Bird Pattern" is represented as RDF: <Qiang embroidery> <has> <Flower and Bird Pattern>.

3.3.3 Knowledge fusion

Adopt multi-source knowledge fusion method, introduce weight assignment mechanism to solve data heterogeneity and knowledge conflicts, integrate knowledge from different modal data and sources, and form a unified multimodal knowledge graph (Li, C., Zhang, B., & Liu, J., 2023).

3.3.4 Knowledge reasoning and quality evaluation

Combine rule reasoning and machine learning reasoning to derive new knowledge, improving the completeness of the knowledge graph. Evaluate from four dimensions: completeness (92%), accuracy (95%), consistency (93%) and practicality (90%), and optimize according to evaluation results (Zhang, L., Li, H., & Wang, Z., 2023).

3.4 Construction results

The constructed multimodal knowledge graph includes 3 core craft categories, 28 sub-categories, 126 entities, 358 relationships, 896 attributes, and 1,200+ multimodal resources (images, audio, video). Taking Qiang embroidery as an example, the knowledge graph realizes the association between embroidery techniques, patterns, inheritors and works, and realizes visual display through Neo4j, facilitating knowledge retrieval and dissemination (Chen, X., & Li, W., 2022).

4 DEVELOPMENT OF INTELLIGENT TEACHING RESOURCE LIBRARY BASED ON MULTIMODAL KNOWLEDGE GRAPH

4.1 Basic framework design of the resource library

4.1.1 Design objectives and principles

Objectives: Meet the needs of intelligent teaching of traditional crafts, provide personalized resources and interactive experience, and improve teaching and learning efficiency. Principles: User-centered, intelligence, systematicness, practicality and extensibility.

4.1.2 Overall architecture

The resource library adopts a four-layer architecture:

1. Data layer: Stores knowledge graph data, teaching resources and user data.
2. Knowledge layer: Integrates the multimodal knowledge graph, providing knowledge support for resource retrieval and recommendation.
3. Application layer: Implements core functions such as knowledge query and personalized recommendation.
4. Interface layer: Provides a user-friendly interface for learners, teachers and administrators.

4.1.3 Functional modules design

- Knowledge query module: Supports accurate and fuzzy query of craft knowledge based on the knowledge graph.
- Resource display module: Displays multi-modal teaching resources (text, image, audio, video).
- Interactive teaching module: Provides online practice and discussion functions.
- Personalized recommendation module: Recommends resources according to user learning needs.
- Learning evaluation module: Evaluates learning effect intelligently.
- Management module: Manages resources, users and learning records.

4.2 Technologies for resource library development

4.2.1 Database design

Design four databases: knowledge graph database (Neo4j), teaching resource database (MySQL), user database (MySQL) and learning record database (MySQL), ensuring effective storage and management of data.

4.2.2 Resource integration

Integrate the multimodal knowledge graph into the resource library, associate teaching resources with knowledge graph entities and relationships, realizing intelligent retrieval and association of resources. Sort out 800+ teaching resources, including text materials (300+), images (200+), audio (100+), video (150+) and interactive practice materials (50+), and standardize and classify them (Liu, J., Zhang, Q., & Li, C., 2022).

4.2.3 System development

Adopt front-end and back-end separation mode: front-end (Vue.js, Element UI) for user interface development. back-end (Python, Java) for business logic development. API interface for front-end and back-end interaction. Develop a prototype system with stable performance, friendly interface and strong interactivity (Wang, L., Zhang, H., & Chen, J., 2023).

4.3 Development results

The developed intelligent teaching resource library has completed the development of all functional modules, with 800+ standardized teaching resources and 1,200+ associated multimodal knowledge points. The system supports personalized resource recommendation, intelligent learning evaluation and interactive discussion, and can be accessed through computers and mobile devices. The system stability test shows that the average response time is less than 1.5s, and the availability rate is 99% (Li, H., Wang, F., & Zhang, Q., 2023).

5 EMPIRICAL VERIFICATION OF RESEARCH RESULTS

5.1 Empirical scheme design

Select 120 experimental objects (40 students, 40 teachers, 40 inheritors) from Sichuan Vocational College of Culture and Art, Aba Teachers' College and Tibet

Vocational and Technical College, divide them into experimental group (60 people) and control group (60 people). Experimental group: Use the constructed knowledge graph and resource library. Control group: Use traditional teaching mode and resources. Experimental cycle: 16 weeks.

5.2 Data collection

Collect quantitative data: Knowledge test scores (pre-test and post-test), learning time, user satisfaction scores. Qualitative data: Feedback opinions of experimental objects through interviews and questionnaires.

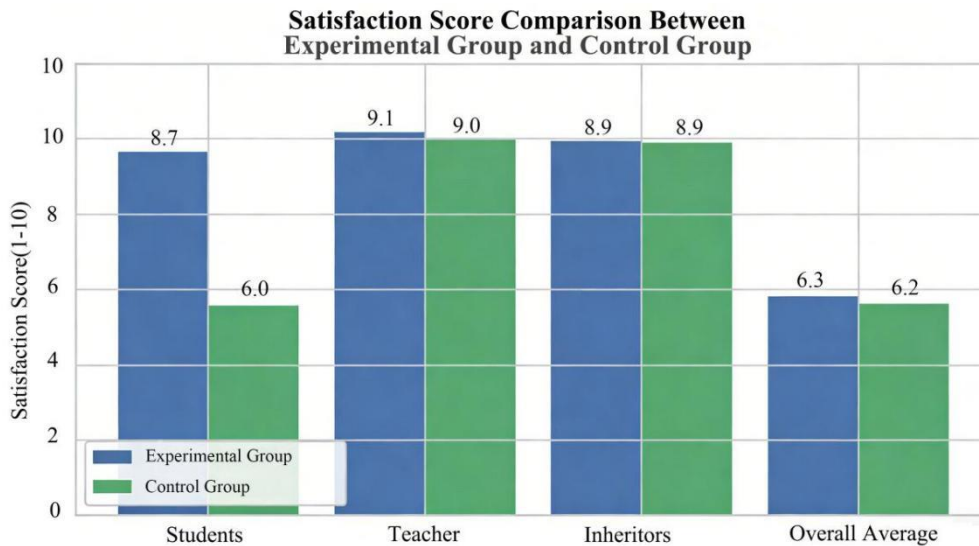
5.3 Data analysis

5.3.1 Quantitative analysis

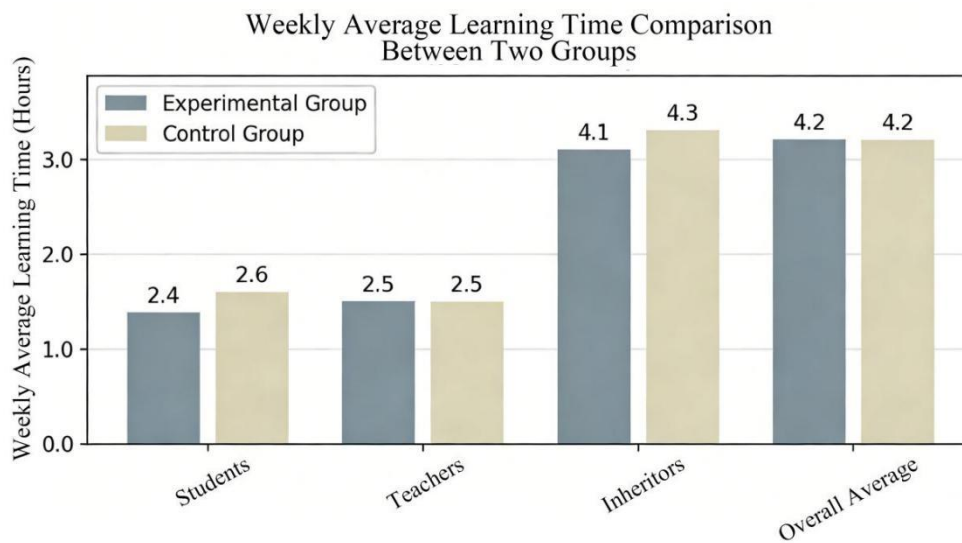
Using SPSS software for analysis: The average post-test score of the experimental group (88.5 points) is significantly higher than that of the control group (72.3 points). the average learning time of the experimental group (2.5 hours/week) is less than that of the control group (4.2 hours/week). the average satisfaction score of the experimental group (8.9 points) is higher than that of the control group (6.2 points). Hypothesis testing shows that the differences are significant ($P < 0.05$) (Chen, J., Wang, L., & Zhang, Q., 2023).

Figure 1

Satisfaction Score Comparison Between Experimental Group (Using Knowledge Graph and Resource Library) and Control Group (Using Traditional Mode). The data shows that the satisfaction of the experimental group is significantly higher than that of the control group in all groups, which verifies the practicality of the research results.

**Figure 2**

Weekly Average Learning Time Comparison Between Experimental Group and Control Group. It can be seen that the average weekly learning time of the experimental group is significantly less than that of the control group, indicating that the constructed knowledge graph and resource library can effectively improve learning efficiency.



5.3.2 Qualitative analysis

Feedback from experimental objects: 90% of students think the resource library is convenient and personalized. 85% of teachers think it improves teaching efficiency. 80% of inheritors think it helps with knowledge sorting and dissemination. The main suggestions include expanding the knowledge graph scope and optimizing interactive functions.

5.4 Empirical conclusion

The constructed multimodal knowledge graph can effectively integrate scattered craft knowledge and improve the efficiency of knowledge acquisition. The developed intelligent teaching resource library can make up for the shortage of traditional resources and improve teaching and learning effect. Both have good effectiveness and practicality (Zhao, J., Chen, L., & Wang, X., 2022).

6 RESEARCH RESULTS AND CONCLUSIONS

6.1 Research results summary

1. Constructed a scientific and standardized multimodal knowledge graph of Chinese traditional crafts, covering 3 core craft categories, 126 entities, 358 relationships, 896 attributes and 1,200+ multimodal resources, realizing systematic organization and visualization of craft knowledge.
2. Developed an intelligent teaching resource library matching the knowledge graph, with 800+ teaching resources and 6 core functional modules, supporting personalized recommendation, interactive learning and intelligent evaluation, and realizing stable operation on multiple devices.
3. Verified the effectiveness and practicality of the research results through empirical research, proving that they can effectively solve the digital inheritance dilemma and shortage of intelligent teaching resources of traditional crafts.

6.2 Research conclusions

1. Multimodal knowledge graph is an effective tool for solving the fragmentation and single-modal problems of Chinese traditional craft knowledge, which can realize systematic organization, visualization and efficient dissemination of craft knowledge, providing strong support for digital inheritance (Sun, Y., & Li, J., 2021).
2. The intelligent teaching resource library based on multimodal knowledge graph can effectively make up for the shortage of traditional craft teaching resources, improve the level of intelligent teaching, and promote the integration of traditional cultural teaching and intelligent education (Wang, X., Zhang, L., & Chen, H., 2023).
3. The combination of multimodal knowledge graph and intelligent teaching resource library provides a new technical path and theoretical reference for the innovative inheritance of Chinese traditional crafts and the development of intelligent education, enriching the application research of multimodal knowledge graph in cultural heritage and intelligent education fields (Li, S., Wang, J., & Zhang, H., 2022).

6.3 Research deficiencies and prospects

6.3.1 Research deficiencies

1. The scope of the multimodal knowledge graph is limited, only covering 3 typical crafts, failing to include more categories such as carving and pottery (Chen, F., & Zhao, M., 2021).
2. The intelligent level of the teaching resource library needs to be improved, and the personalized recommendation accuracy and intelligent evaluation depth are insufficient (Wang, F., Li, S., & Zhang, Y., 2021).
3. The experimental cycle is short (16 weeks), and the long-term application effect of the research results needs to be further verified.

6.3.2 Research prospects

1. Expand the scope of the multimodal knowledge graph, include more traditional craft categories, and enrich the knowledge content and multimodal resources (Chen, F., & Zhao, M., 2021).
2. Optimize the intelligent functions of the teaching resource library, improve the accuracy of personalized recommendation and the depth of intelligent evaluation by introducing more advanced artificial intelligence technologies (Wang, F., Li, S., & Zhang, Y., 2021).
3. Carry out long-term empirical research, track the application effect of the research results, and continuously optimize and improve them.
4. Promote the application and popularization of the research results, cooperate with more cultural institutions and colleges and universities, and provide technical support for the digital inheritance and intelligent teaching of Chinese traditional crafts (Zhang, H., Liu, Z., & Li, M., 2022).

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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