



# Research on the Application of Knowledge Graph in Higher Education of Art and Design

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**Abstract.** This paper investigates the application of knowledge graphs in higher education for art and design, analyzing their potential impact on enhancing teaching quality, fostering students' innovative capabilities, and developing critical thinking skills. Art and design education is currently confronting challenges posed by rapid technological advancements, interdisciplinary integration, and a growing demand for personalized education. Knowledge graphs, as a novel means of knowledge representation and organization, improve the efficiency of information retrieval, analysis, and utilization by structuring information. The study proposes that constructing knowledge graphs specific to the field of art and design can integrate multi-dimensional knowledge, offering students a comprehensive and systematic resource repository for learning, assisting educators in curriculum design, and evaluating student work. Using the experimental practice courses at the School of Arts, Sichuan University, as a case study, the paper demonstrates the application of knowledge graphs in curriculum design, personalized learning paths, innovative teaching methods, and a multi-dimensional assessment system. Furthermore, it elucidates how knowledge graphs can promote professional development for educators and the continuous optimization of educational content.

**Keywords:** Knowledge Graph, Art and Design Education, Laboratory Teaching, Personalized Learning.

## 1 Introduction

Art and design education constitutes a crucial component within higher art education, where educators and scholars are continually seeking new pedagogical methods and tools to propel its ongoing development and evolution. Higher education in art and design has transformed from the traditional craftsmanship and apprenticeship models to a more comprehensive discipline that emphasizes innovation, practical experience, and the integration of theory [1]. Despite notable progress in art and design education,

challenges persist in combining traditional arts with modern design concepts, fostering students' creative capabilities and critical thinking, and effectively managing the growing resources in art and design.

In recent years, knowledge graphs have emerged as a novel means of knowledge representation and organization, demonstrating significant potential in various fields. By structuring complex information and knowledge in a graph format, knowledge graphs enhance the efficiency and intuitiveness of information retrieval, analysis, and utilization. In education, the application of knowledge graphs is beginning to transform traditional teaching models, facilitating personalized learning and intelligent recommendation of educational resources [2].

The application of knowledge graphs in art and design education offers new perspectives and tools to address these challenges. Constructing knowledge graphs specific to the field of art and design can integrate multi-dimensional knowledge encompassing theories, history, techniques, and styles, providing students with a comprehensive and systematic resource repository. Furthermore, knowledge graphs can assist educators in curriculum design, student assessment, pedagogical research, and fostering collaboration among students.

This paper discusses the application scenarios and frameworks of knowledge graphs in higher art and design education, and analyzes their potential impact on enhancing teaching quality and promoting students' innovative abilities and critical thinking skills. It aims to provide art and design educators with new pedagogical strategies and tools to meet the trends of modernization and internationalization in education.

## **2 Challenges in Contemporary Higher Education for Art and Design**

As technological innovation, societal demands, and global trends evolve continuously, there is an increasing demand for nurturing talent in art and design. This poses a series of new challenges for higher education institutions in the teaching process of art and design. The rapid changes in technology, the complexity of interdisciplinary integration, and the growing need for personalized education, among other factors, contribute to the complexity and diversification of difficulties that need to be addressed in the development of art and design education [3].

### **2.1 Rapid Technological Development and Curriculum Updates**

The field of art and design is undergoing profound transformations driven by digital technology, with new technologies such as 3D printing, virtual reality, augmented reality, and artificial intelligence emerging rapidly and changing the means and forms of artistic creation. The iterative speed of these technologies is exceptionally fast, requiring educators and students to engage in continuous learning to keep pace with technological advancements. Curriculum content needs constant updates to maintain its relevance, ensuring that students can master the latest tools and skills to meet in-

dustry demands. Additionally, universities need to invest resources to update hardware facilities, software licenses, and instructional materials, which may require substantial funds and time. The professional development of teachers also faces challenges, as they need to constantly update their skills and knowledge to teach the latest technologies. Students, too, need to quickly adapt to new technologies and tools, placing higher demands on their learning capabilities and adaptability. Furthermore, as technology advances, industry standards are constantly changing, necessitating timely adjustments to educational content to accommodate these changes. Educators also need to develop new teaching methods that utilize new technologies to enhance teaching effectiveness and incorporate ethical and legal issues into teaching, helping students understand and address these issues.

## **2.2 Integration of Interdisciplinary Education**

Art and design have expanded from solely focusing on aesthetics and craftsmanship to intersecting with multiple disciplines such as technology, business, and sociology. This trend demands that art and design education offer comprehensive learning experiences that enable students to connect across different fields and develop cross-disciplinary thinking. However, integrating teaching content and methods from different disciplines is a complex task, requiring educators to possess interdisciplinary knowledge and perspectives, as well as to develop new teaching models and curriculum structures. This involves not only the design of curriculum content but also teaching methods, assessment systems, and faculty building. Educators must find ways to organically integrate art and design with knowledge from other disciplines to promote students' innovative thinking and ability to solve complex problems. Moreover, interdisciplinary education requires universities to make corresponding adjustments and optimizations in resource allocation, policy support, and academic research to meet the needs of educational integration.

## **2.3 Personalization and Cultivation of Innovative Abilities**

Art and design education emphasizes personalized creative expression and the cultivation of innovative thinking, requiring education to not only impart knowledge and skills but also to stimulate students' creativity and independent thinking abilities. In this process, educators face the challenge of implementing personalized teaching within a standardized educational system, involving a deep understanding of each student's interests, abilities, and learning styles, and providing customized learning experiences accordingly. Furthermore, fostering innovative abilities necessitates an environment that supports experimentation, encourages exploration, and tolerates failure. Educators must design teaching methods and courses that promote these qualities. Additionally, assessing personalization and innovative abilities presents a challenge, as they are often not easily quantifiable, requiring a more diverse and flexible evaluation system. Achieving these goals is particularly difficult in large-scale educational environments, as it requires educators to identify and meet the specific needs of each student while creating a supportive environment for innovation and

experimentation. This not only tests the wisdom and creativity of educators but also places higher demands on the resources, policies, and culture of universities.

### **3 Solutions Offered by Knowledge Graphs to Challenges in Higher Education for Art and Design**

Education is fundamentally about the transmission and innovation of knowledge [4]. The powerful application capabilities exhibited by knowledge graphs in organizing and representing knowledge provide worth-exploring solutions to the challenges faced by higher education in art and design.

#### **3.1 Knowledge Graphs: Solving the Rapid Development of Technology and Curriculum Updates**

As a highly interconnected information network, knowledge graphs can integrate and update the latest technological developments and industry trends in real time. By linking to the latest online tutorials, technical forums, research papers, and case studies, they provide educators and students with a dynamic learning resource repository. This dynamism of knowledge graphs ensures that teaching content can reflect the latest technological advancements promptly, helping students master cutting-edge tools and skills [5].

Knowledge graphs can also facilitate the alignment between universities and industries. By integrating industry standards and demands, knowledge graphs can assist universities in adjusting teaching content timely, ensuring that what students learn aligns with industry needs. This not only enhances students' employability but also cultivates talents who better meet the requirements of the art and design industry.

#### **3.2 Knowledge Graphs: Solving the Integration of Interdisciplinary Education**

Knowledge graphs create a multidimensional, interconnected knowledge structure that can integrate information and concepts from different disciplines. This structured approach enables students to explore and learn interdisciplinary content within a unified framework, thereby promoting the integration of knowledge and skills across disciplines.

Knowledge graphs can relate the foundational theories of art and design to Knowledge points from other disciplines such as technology, business, and sociology, forming a comprehensive knowledge network. This network not only helps students understand the position of art and design in a broader sociocultural context but also inspires them to adopt an interdisciplinary perspective in design practice.

Knowledge graphs can serve as the foundation for course design, aiding educators in developing interdisciplinary courses and projects. Through knowledge graphs, teachers can easily identify connection points between different disciplines and design

educational activities around these connection points, allowing students to apply interdisciplinary knowledge practically.

### **3.3 Knowledge Graphs: Solving Personalization and Cultivation of Innovative Abilities**

Knowledge graphs can capture and reflect the nuances in students' learning processes in art and design, thereby providing customized learning experiences. They optimize recommendation algorithms by tracking student interactions and feedback, ensuring that students are exposed to content that stimulates their creativity and learning enthusiasm. Customized resource recommendations based on the specific needs of educators and students achieve a personalized learning experience. By analyzing learning behaviors and outcomes, knowledge graphs can identify learners' interests and ability levels, subsequently recommending the most suitable learning materials and courses. This personalized learning path not only enhances students' learning efficiency but also sparks their interest and innovative thinking.

Knowledge graphs can link to a wide range of creative resources, such as design cases, artworks, and innovative tools, providing students with abundant sources of inspiration. These resources can broaden students' horizons and encourage them to explore new design methods and forms of expression. Furthermore, knowledge graphs can also serve as a collaborative platform for innovative projects and research. Students can use knowledge graphs to organize and showcase their creativity, engaging in exchanges and collaborations with classmates and teachers. This collaborative environment helps cultivate students' teamwork and project management skills.

## **4 Application of Knowledge Graphs in Higher Education for Art and Design: A Case Study of the "Experimental Course Group at the College of Arts, Sichuan University"**

The Experimental Teaching Center of the College of Arts at Sichuan University has reformed and innovated experimental teaching to better meet the needs of higher education in art and design in the new era. Based on the existing six types of craft equipment at the Experimental Teaching Center—woodworking, 3D printing, virtual simulation, ceramics, screen printing, and laser processing—and the online education platform "Da Chuan Academy" of Sichuan University, a knowledge graph for the experimental teaching course group in art and design has been constructed.

### **4.1 Construction of the Knowledge Graph and Course Group Structure Design**

A comprehensive knowledge graph is constructed, with each node representing a craft technology and its related design applications, such as woodworking, 3D printing, virtual simulation, ceramics, screen printing, and laser processing. These craft nodes

are connected to other key domains like design theory, materials science, and art history, forming a multidimensional knowledge network.

The course group structure is designed around these craft devices, offering basic, advanced, and interdisciplinary application courses. For example, woodworking and ceramics can be combined with materials science and art history, while 3D printing and laser processing can integrate with modern design and engineering principles, and virtual simulation can link to digital art and interactive design.

#### **4.2 Personalized Learning Pathways and Integration of Teaching Resources**

Utilizing the Da Chuan Academy online learning platform, the knowledge graph is integrated with specific teaching resources. Detailed teaching modules are established for each craft technology, including theoretical explanations, operational videos, and case analyses. Through online testing and surveys, student background information, interests, and ability levels are collected to create student profiles.

Based on these profiles, the recommendation system within Da Chuan Academy's knowledge graph provides students with personalized learning pathways, including course recommendations, learning resource suggestions, and practical project advice. Students can choose their learning paths based on individual interests and needs for online learning and offline practice.

#### **4.3 Innovative Teaching Methods and Interactive Learning Environments**

Teaching methods driven by cases and projects are adopted, allowing students to learn and apply knowledge by analyzing and solving real-world problems using the case library and project resources in the knowledge graph.

An interactive learning environment is created to encourage student participation in discussions, collaboration, and innovation. Online collaboration tools from Da Chuan Academy, such as forums, group assignments, and real-time communication, facilitate interactions between teachers and students as well as among students themselves. Additionally, utilizing the physical workshops of the Art College's Experimental Teaching Center, students engage in hands-on practice with craft equipment.

#### **4.4 Multidimensional Assessment System and Professional Development for Teachers**

A multidimensional assessment system is established to evaluate students' knowledge mastery, skill application, innovative abilities, and teamwork skills through online tests, project reviews, and peer evaluations.

Teachers are provided with resources from the knowledge graph to support their mastery of new technologies, teaching methods, and international educational standards. Online training and academic exchanges through Da Chuan Academy facilitate professional development for teachers and enhance teaching quality.

#### **4.5 Continuous Optimization Mechanism**

A continuous optimization mechanism based on feedback from students and teachers is established to constantly update the content of the knowledge graph and teaching methods. This mechanism is implemented through online surveys, teaching feedback, and showcases of achievements, ensuring that the teaching course group remains up-to-date and meets the needs of students and society.

Through this detailed set of designs, the College of Arts at Sichuan University can fully leverage the knowledge graph and the Da Chuan Academy online learning platform to achieve personalization of teaching content, innovation in teaching methods, diversification of the assessment system, and internationalization of education. At the same time, it promotes professional development for teachers and the continuous optimization of the teaching course group.

### **5 Conclusion**

The integration of knowledge graphs in art and design education provides innovative pathways to address the challenges of educational modernization. By organizing and updating teaching resources in a structured and interconnected manner, it ensures the timeliness and relevance of educational content. The practical case from the College of Arts at Sichuan University elaborately illustrates the application of knowledge graphs in course design, personalized learning, innovative teaching methods, and the construction of assessment systems. These practices not only enhance the interactivity of teaching and student engagement but also promote professional growth among teachers and continuous improvement of teaching content. The use of knowledge graphs offers a flexible teaching model for art and design education that adapts to the rapidly changing social needs, helping to cultivate students' comprehensive qualities and innovative practical abilities, and pushing art and design education towards higher-level development.

### **Funding Information**

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2. Sichuan University AI Course Construction Project Based on Knowledge Graph: Art Experimental Practice Course Group.

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