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Art Education in China in the Context of the Artificial Intelligence Era: Research Hotspots and Future Trends

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Abstract

Generative artificial intelligence demonstrates significant potential in the field of "artistic creation" due to its exceptional "content generation" capabilities. As machines engage in the practice ground of human creativity and imagination—artistic creation—the advent of "machine presence" in the realm of aesthetic education becomes evident. Against this backdrop, this study, situated within the macro context of the artificial intelligence era, conducts an in-depth analysis of research literature related to AI art education in China from 2014 to 2024. By employing bibliometric methods and utilizing the visualization software CiteSpace 6.3.R1, this study analyzes the data from integrated literature in terms of publication volume, institutions, keywords, and other factors. Through co-occurrence data analysis and other methods, relevant data maps are constructed to examine the research hotspots and development trends in the field of AI art education applications in China over the past decade. The aim is to provide valuable references and insights for researchers and practitioners involved in online learning and research.

Keywords

Artificial intelligence; aesthetic education; art education.

1. Introduction

Art is increasingly permeating technology, providing new perspectives for technological development[1]. Technology not only diversifies the mediums of artistic creation and expands the speed and breadth of dissemination but also gives rise to new forms of art, alters methods of creation, and even challenges our original concepts of art, aesthetics, and creativity. Consequently, art education must evolve accordingly. To better grasp the future positioning and direction of art education, this paper aims to explore the changes, hotspots, and trends that the rise and development of new technologies such as artificial intelligence have brought to the fields of art and art education. This study seeks to enhance the value of art education by reviewing relevant literature. By employing CiteSpace 6.3.R1 software for a comprehensive and systematic summary, we present a more intuitive and three-dimensional depiction of the practical applications of AI-generated content (AIGC) in Chinese art education over the past decade. This analysis aims to provide a reference for further advancing research on AI applications in the field of art education.

2. Methods

2.1. Research Methods

This study primarily utilizes a literature review approach to comprehensively integrate research literature and typical case studies related to AI in art education in China from 2014 to 2024. The objective is to clarify current research hotspots in AI in art education in China, forecast its development trends, and apply bibliometric methods. Additionally, the study

employs visualization software CiteSpace 6.3.R1 to conduct data analysis on integrated literature. This analysis encompasses publication volume, affiliations, keywords, and employs co-occurrence data analysis to construct relevant data maps. These efforts aim to analyze the research hotspots and future prospects in the application of AI in art education in China over the past decade.

2.2. Data Sources

In the advanced search mode of China National Knowledge Infrastructure (CNKI), the "professional search" option was selected to restrict the scope to the "subject" field and comprehensively search all Chinese literature covering the specified keywords. The search scope was defined as "SU=(artificial intelligence+AI+AIGC+image-based artificial intelligence +image AI+art AI) * (art + fine arts + aesthetic education + design + painting + hand - drawing) * (education)", (original formula:SU＝(人工智能+AI+ AIGC+图像类人工智能+图像AI+艺术AI) * (艺术+美术+美育+设计+绘画+画画+手绘) * (教育)),spanning from January 2014 to June 2024. The sources included SCI, EI, Peking University core journals, and CSSCI indexed journals, yielding a total of 809 records. To ensure the accuracy of the analysis, a systematic optimization process was conducted to exclude notices, announcements, news, reviews, and irrelevant articles, resulting in 25 valid journal articles. Subsequently, using the same search criteria and time frame, theses (master's and doctoral) were searched, initially yielding 1883 results. After further screening, 5 relevant theses were identified. In total, 30 documents were obtained and exported in RefWorks format for subsequent analysis as raw data.

3. Data Compilation and Analysis

3.1. Analysis of Annual Publication Volume and Institutions

By analyzing the distribution of literature publication volume since 2014, research on the application of AI in art education (AIGC) can be divided into three stages: Exploration Stage (2014–2020), Explosive Growth Stage (2021–2022), and Development Stage (2023–2024).Below is Fig. 1, depicting the annual publication volume trend curve.

Exploration Stage (2014–2020): During this period, an average of 1 article per year was published. AI technologies were in the exploratory and refinement stages, particularly in the development and iterative updates of AI functionalities in art. Early machine learning techniques such as image classification laid the groundwork, with milestones like Ian Goodfellow's introduction of Generative Adversarial Networks (GANs) in 2014 heralding a new era in generative art and image creation. Deep learning applications in digital media focused on image or video enhancement, style transfer, image generation, and image or video recognition.

Explosive Growth Stage (2021–2022): This phase saw a total of 12 publications, with 11 articles published in 2022 alone, marking a significant peak in publications. The release of GPT-3 by OpenAI in 2020 propelled AI to unprecedented heights, ushering in a new era. While primarily used for natural language processing (NLP), its advancements greatly influenced interdisciplinary AI research, particularly in arts-related AI applications. This period also saw the emergence of multimodal AI and integrated applications. Consequently, 2022 became the year with the highest volume of research in AI art education, focusing mainly on framework design, ethical considerations, and high-level theoretical designs.

Development Stage (2023–2024): In less than two years, the publication volume exceeded that of the first stage. Due to time constraints of this writing, research papers for 2024 were counted only until June, representing half-year publication data. However, extrapolating from the annual average, it is highly likely that the publication volume for 2024 will surpass the previous peak of 12 articles, indicating a period of rapid development. With the gradual improvement of

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multimodal AIGC systems, related papers increasingly focused on practical applications and started to include case studies and experimental research.

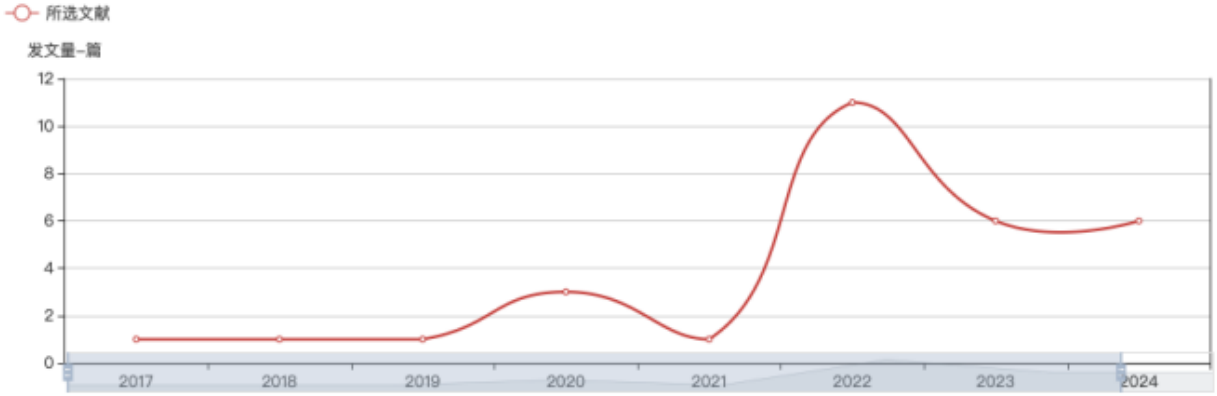

Fig. 1 depicting the annual publication volume trend curve

3.2. Analysis of Publishing Institutions

To understand the publishing trends among various institutions, this study conducted an analysis of the top 40 institutions ranked by publication volume. The findings reveal that, apart from Southwest Minzu University, which accumulated 2 publications, all other institutions contributed only 1 publication each. This indicates that the field is still very new and emerging, with very few research outputs, and no institution has emerged as dominant.In terms of publication timelines, early-stage institutions were primarily engaged in individual research and independent exploration. As the research progressed into the third stage of publication volume analysis, the focus shifted towards application and practical exploration, prompting institutions to transition from individual research to collaborative efforts.By 2024, collaborative research among institutions exceeded independent research for the first time. This trend marks a shift from solitary endeavors to mutually beneficial collaborations. Fig. 2 depicts the co-occurrence network map of collaborative institutions.

Fig. 2 depicts the co-occurrence network map of collaborative institutions

3.3. Keyword and Cluster Analysis

Keywords serve as highly condensed representations of core research topics. Through co-occurrence analysis and cluster analysis of keywords, one can further elucidate the prominent themes in the research on AI in art education (AIGC) in China over the past decade. This study selected the top 60 keywords based on frequency for co-occurrence analysis.Fig. 3 presents the co-occurrence network map of keywords, providing insights into the interrelationships and clustering of key themes in the application of AIGC in art education.

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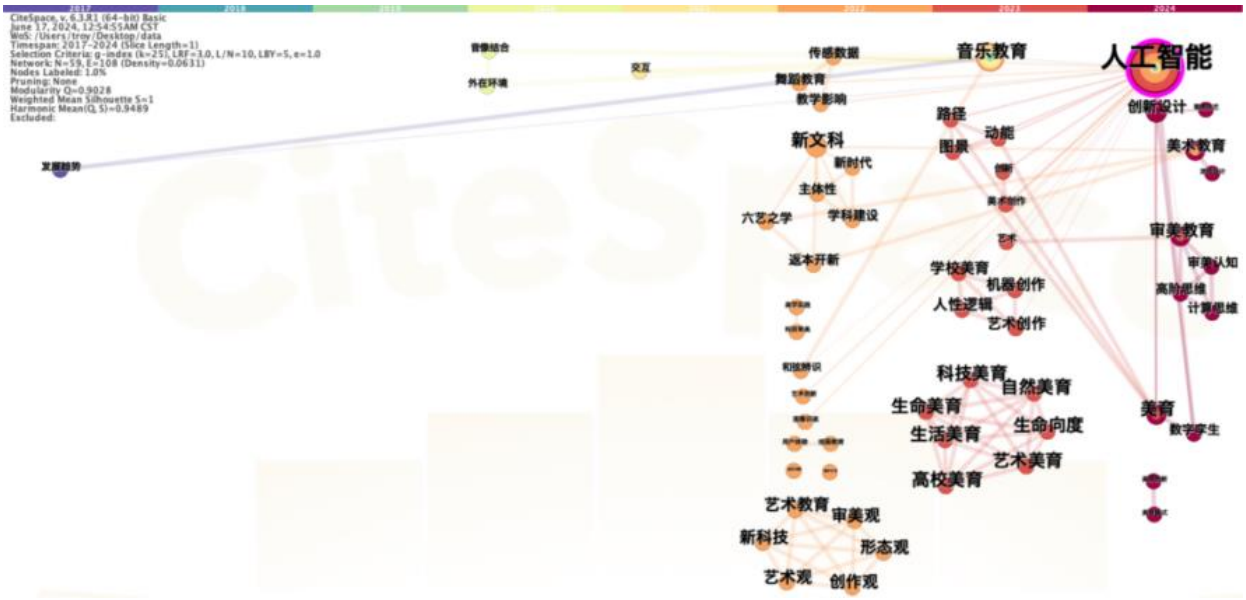

Fig. 3 presents the co-occurrence network map of keywords

From this observation, it is evident that research in this field began to experience explosive growth after 2022, with very few related concepts appearing before then. In 2022, keywords focused on innovation, new era, new concepts, and other macro and ideological themes, indicating that research during this period centered on hypotheses and high-level theoretical designs. By 2022, studies shifted towards creation, pathways, and practical applications, emphasizing research aimed at practical application. By 2024, keywords increasingly emphasized practice, application, and the design and implementation of educational practices, integrating earlier proposed theories. Additionally, AI dimensions expanded to include keywords related to technologies like digital twins.

Using CiteSpace 6.3.R1 for keyword cluster analysis, this study achieved Q = 0.760 and S = 0.9529, meeting research standards for subsequent analysis. The keyword cluster knowledge map identified four clusters: "Embodied intelligent technology, aesthetic education, music education, artistic creation." Fig. 4 illustrates the co-occurrence of cluster labels, while Fig. 5 depicts their temporal distribution.

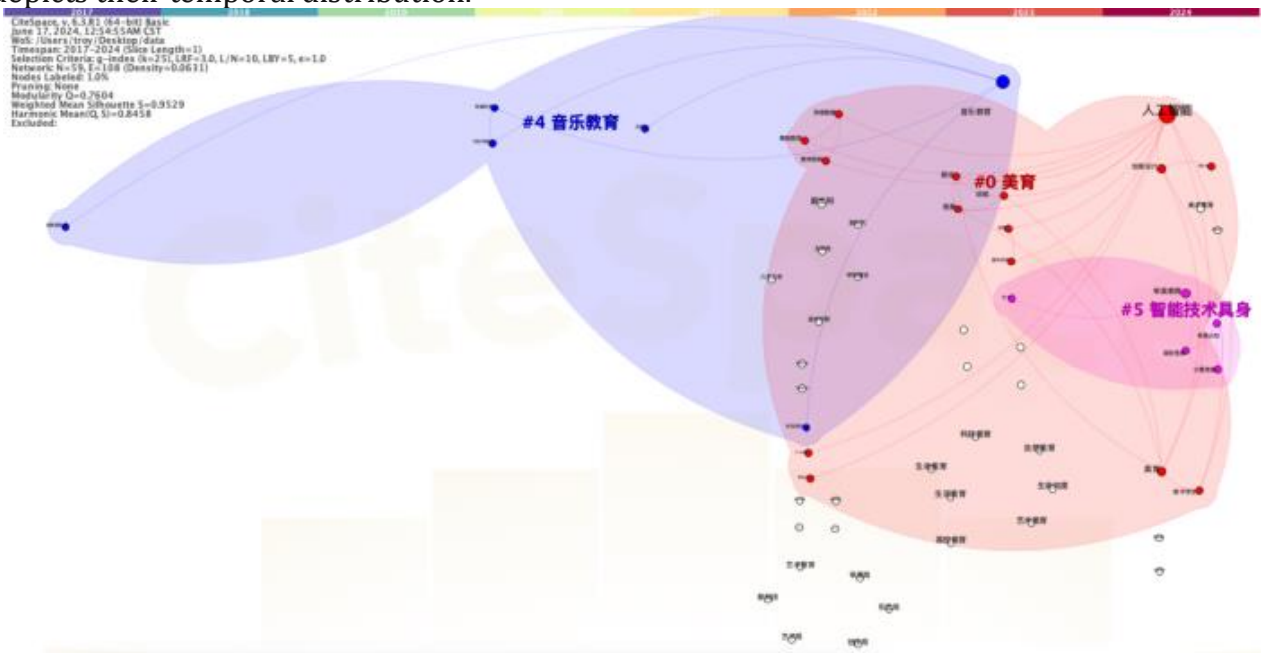

Fig. 4 illustrates the co-occurrence of cluster labels

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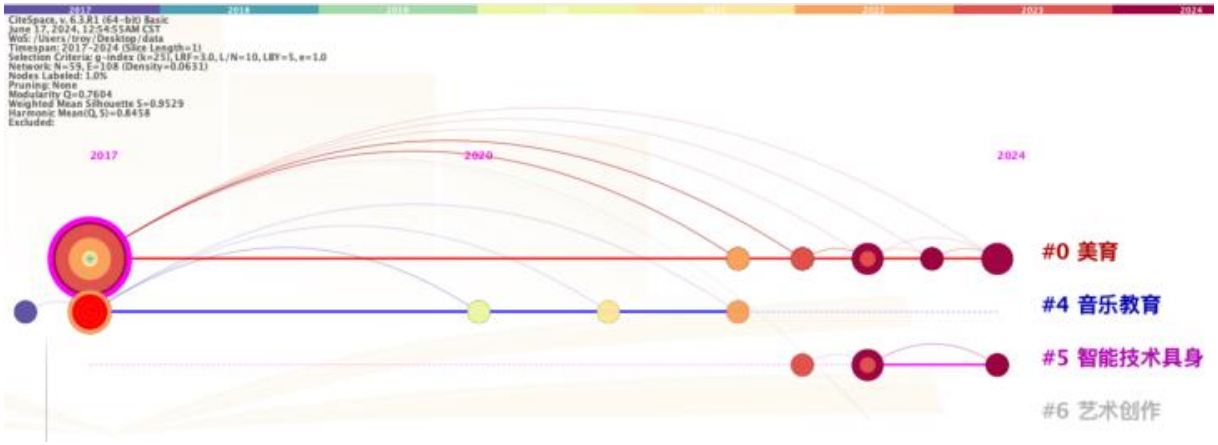

Fig. 5 depicts their temporal distribution

"Music education" is also a burst terms. It begin in 2017 and end in 2021,strength=2.22. These suggest that there was a significant emergence of research related to music education during the early stages of the AI wave. Fig. 6, derived from CNKI export data for analysis, presents a network of literature citations, indicating co-citations and relationships among original, referenced, and citing documents.

Upon analysis of these three graphs, the study concludes that early machine learning and deep learning applications in audiovisual fields sparked scholarly interest in music education. During this period, image processing technologies primarily focused on recognition and stylization, with output quality far from matching human artistic creation. Furthermore, these technologies lacked the aesthetic sense and innovation sought after in the field of fine arts, resulting in limited early research in this area.However, as natural language processing and other domains combined to advance AI content generation, particularly with the advent and enhancement of systems like Dell-E and Midjourney, the study of fine arts experienced explosive growth. This growth ultimately surpassed that in music education. With the maturation of these technologies, research in AI art education practices began to flourish. This shift led to new explorations and practical applications in artistic creation, human-machine collaboration, and embodied cognition.

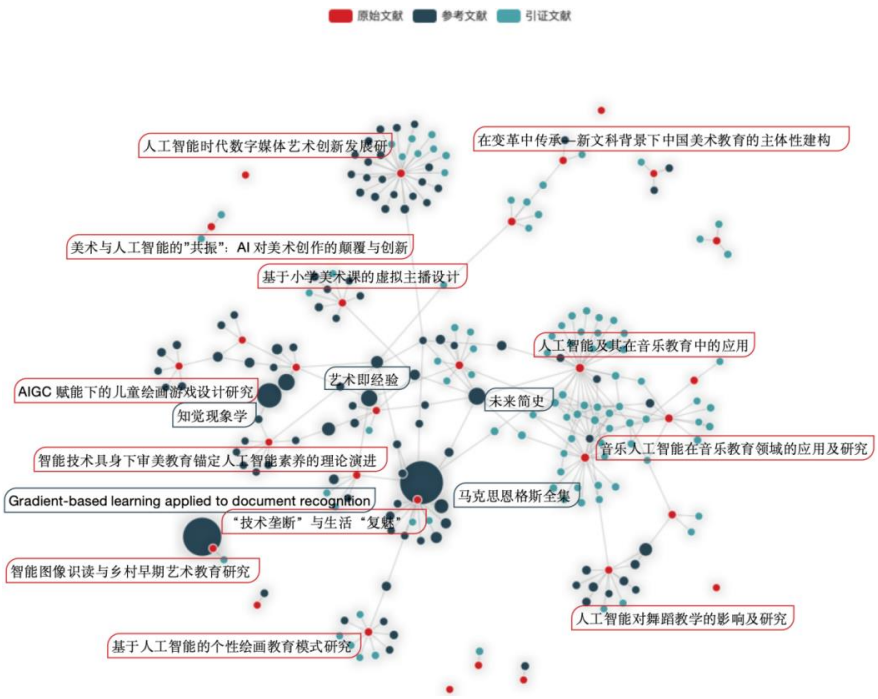

Fig. 6 Network Map of Literature Citation Interactions

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3.4. Analysis of Discipline Distribution

Based on the data exported from CNKI, Fig. 7 illustrates the distribution of disciplines, indicating where this research is primarily applied and validated. It is evident that theoretical research outcomes in education and arts constitute the majority, each accounting for 40%.The field of computer science, known as the birthplace of AI, maintains a strong symbiotic relationship with AI. Within computer science, digital media serves as a major breeding ground for AI art education, focusing predominantly on digital arts and media. Higher education serves as an early practical ground for cutting-edge disciplines, with related research outcomes initially implemented and applied in this field.

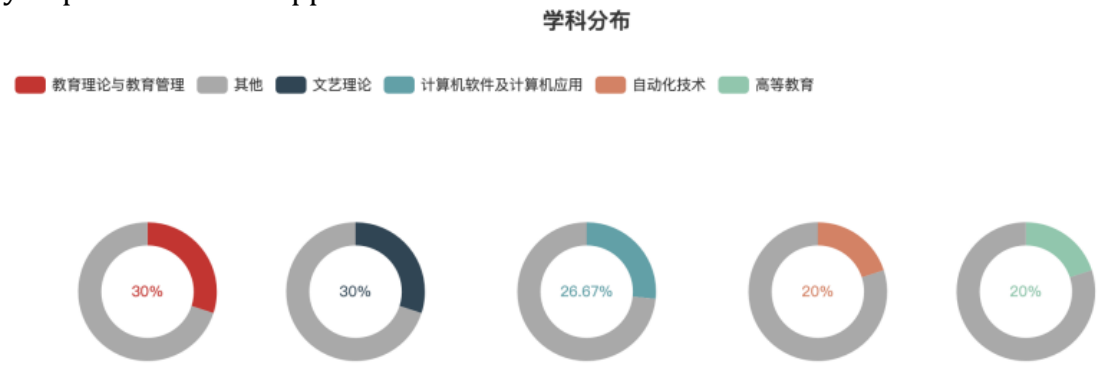

Fig.7. illustrates the distribution of disciplines

4. Results

4.1. Research Focus

4.1.1. Focusing on Aesthetic Education Empowered by AI Literacy

The mode of thinking profoundly influences cognitive patterns, which in turn determine the pathways for acquiring and generating knowledge and experiences. The new generation of students are recognized as natives of the digital space, readily accepting and familiar with the concept and model of technological transparency. They are eager to engage in the latest applications and scenarios of artificial intelligence, enjoying the benefits in learning, work, and life experiences. However, varying levels of AI application and practical skills among students may lead to different degrees of experiential disparity. It is crucial to establish feasible and efficient strategies and models to help guide and assist students in achieving a certain level of AI literacy. Education should draw lessons from talent development in machine learning and seek insights from successful experiences in machine learning and creation[2]. Thus, aesthetic education should guide students to integrate existing knowledge and experiences into the application and innovation of artificial intelligence. Utilizing personalized collaborative services from intelligent technology embodied systems enables mutual nourishment and growth with the intelligent technology system. This approach respects the biological uniqueness and diversity of each student, aligns with the ethical values of human society and the core socialist values, and fully leverages each student's strengths and creative potential. It encourages them to actively participate in the symbiotic mechanism and ecosystem of human and intelligent technology systems, demonstrating their own AI literacy and promoting the advancement of aesthetic cognition.

4.1.2. Guiding the Leap of Intelligent Technology Embodiment through Collaborative Creation as an Aesthetic Ideal

Intelligent technology embodiment involves shaping, substituting, extending, and extending human body organs, which offers possibilities for human creativity. Indeed, the history of human progress is a history of "mutual training" between the body and technology. From the perspective of artificial intelligence, the key to the competition between human intelligence and

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artificial intelligence lies not in the rational dimension but in the non-rational, specifically the sensory dimension[3]. In the aesthetic education scenarios and environments of intelligent technology embodiment, students' AI literacy will spontaneously adjust to the adaptive relationship with intelligent machines, gradually establishing mechanisms for human-machine collaborative creation, and continuously exploring innovative models for human-machine fusion co-creation. In this progressive evolution process, students' innovative awareness is activated, leading them to capture creative inspiration, shape creative images, and to some extent, achieve aesthetic ideals and gain aesthetic value. While innovation and creation are based on logical thinking such as concepts, judgments, and reasoning, sensory thinking such as imagination and enlightenment are key elements of innovation and creation. Students need to restrain and break free from logical thinking to stimulate creativity. Although rational components participate in aesthetic activities, the pinnacle of aesthetic experience is determined by sensory components. Aesthetic consciousness is the unity of knowing and feeling. Consciousness has self-referentiality, which is fully manifested in the identity of the subject and object in aesthetic activities, where students are both aesthetic subjects and objects. Students' aesthetic activities involve two major stages— aesthetic cognition and meta-aesthetic cognition. The former involves students' aesthetic processing of external objects, while the latter involves students' aesthetic processing of internal objects, using meta-cognitive systems to explore the embodiment of their own mind-body consciousness through meta-perception, meta-evaluation, meta-creation, meta-improvement, and meta-experience, ultimately achieving their highest aesthetic value goals[4].

4.2. Future Development of Art Education in the Era of Artificial Intelligence

4.2.1. Exploration of Artificial Intelligence Art

In the collaborative creative process between humans and machines, the inherent "process," the artwork's "systematic nature," and the medium's "computability" collectively constitute the characteristics of "intelligence"[5]. Various intelligent media as creative tools make the creative process computable and gradually develop a trend beyond the artwork itself towards the process. In the creative process of AIGC, data and algorithms serve as new non-material mediums, requiring artists to shift their research focus from the entity to the process of artwork generation itself. Artists need to analyze the "process" in artistic creation, acknowledging the gradual subjectivity of intelligent machines in artistic creation. In the construction of subjectivity in artificial intelligence art, artists can collaborate with intelligent machines, establishing a new cooperative mode with intelligent systems. This collaborative mode transforms artistic creation from a singular, linear process into a complex, interactive, and evolving system. This shift in creative identity and perspective can provide new practical insights for artificial intelligence art.

4.2.2. Cognitive Leap in Art Appreciation Education

Systematic evaluation of artworks is a crucial step for correcting and ensuring quality in creation. Through a comprehensive model evaluation of systematic aesthetics and behavioral aesthetics, shortcomings in creation can be identified to optimize artworks. Systematic aesthetic evaluation primarily focuses on the overall structure and functionality in artistic creation, including the goals, boundaries, structure, inputs, and outputs of artworks. Evaluating these aspects helps determine whether the artwork meets the creator's requirements and achieves the intended functionality. Behavioral aesthetic evaluation focuses on the behavioral performance of artworks, including behavioral levels, characteristics, and patterns. The evaluation system of creative systems not only helps optimize practical solutions for artificial intelligence art but also enhances and improves artistic creation models through a comprehensive consideration of systematic and behavioral aesthetic evaluations. Starting from a "process-based aesthetic system," a systematic aesthetic system that integrates "process" into

systematic thinking of aesthetics is reconstructed.These developments illustrate the evolving landscape of art education in the era of artificial intelligence, highlighting the integration of computational creativity, collaborative creation, and systematic aesthetic evaluation as pivotal areas for future exploration and advancement.

4.2.3. From Deterministic, Individualistic Creation to Generative, Collaborative Creation

New technologies not only provide new creative tools but also enable artistic creation to transition from individual to collective efforts. Under the influence of mechanical time-space perspectives and traditional media domination, artistic creation was relatively individualistic. Artists conceived and created their work in specific time-spaces, resulting in completed artworks that possessed determinacy and finality, reflecting a linear and closed relationship characteristic of the pre-internet era. The hallmark of the internet age, however, is the construction of a structure that breaks through time-space limitations and interweaves multidimensional relationships through digital technology networks. Today, hyperlinked and open relationships have replaced singular linear and closed relationships.This networked relationship resembles underground bamboo roots that spread in all directions, intertwining to form a vast underground rhizomatic system, echoing the "rhizomatic thinking" advocated by the French philosopher Deleuze. It is not linear or deterministic but interactive and generative. New learning methods enabled by networked digital technology have prompted reflections on traditional individualistic cognitive views. Distributed cognition[6] illustrates that learning supported by network technologies is no longer just an internal process of self-constructing knowledge within individuals. Bruns (2010) proposed the concept of "distributed creativity," highlighting that creativity emerges not from a single person, text, or technology but from geographically separated yet networked individuals, texts, and technologies[7]. This shift in understanding creativity emphasizes the social and cultural attributes that foster creativity, underscoring the critical role of cultural environments and social relationships in its expression.

4.2.4. Cross-Disciplinary Integration

For artists, interdisciplinary collaboration is key to breaking creative barriers. Specifically, establishing interdisciplinary laboratories that collaborate with members from different fields and adopting a "practice-based research" approach is crucial for contemporary artistic creation. This approach emphasizes both the research object and the research process, positioning artistic practice between production and research[8]. Artistic production for artists is no longer limited to works exhibited in art museum systems. Instead, artistic creations generated during the practical process, along with technological patents and academic papers, collectively constitute the three main outputs of interdisciplinary laboratories.In cross-disciplinary artistic creation facilitated by intelligent machines, creativity is not merely an intuitive or artistic output. The systematic and computable aspects determine new breakthroughs in creative methods. Systems aesthetics and behavioral aesthetics integrated into practical research, constructed through sensors and computable media, represent a fusion of artistic systems that embody both systematic and behavioral aesthetics.

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