



EXPLORING FACTORS INFLUENCING THE INTEGRATION OF DRAWING TOOLS IN ARTS AND DESIGN EDUCATION

*EXPLORACIÓN DE LOS FACTORES QUE INFLUYEN EN LA INTEGRACIÓN DE
HERRAMIENTAS DE DIBUJO EN LA EDUCACIÓN EN ARTES Y DISEÑO*

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Abstract

The purpose of this study is to explore the factors that influence the integration of using artificial intelligence drawing tools into art and design education in colleges and universities. To integrate AI technology into art design education, it is first necessary to clarify the

effect of the application of AI technology in the education process. Through the methods of literature review, case study, and practical teaching, we analyze the potential and influencing factors of the application of AI in education by integrating the theoretical foundations of art and design teaching with AI. This study summarizes the effects and possible shortcomings of the application of artificial intelligence from the case of universities in China and proposes corresponding countermeasures. The conclusions of the study can provide theoretical support and practical guidance for the application of artificial intelligence in art and design teaching.

Keywords

artificial intelligence drawing tools, art and design education, application effect, shortcomings and countermeasures.

Resumen

El propósito de este estudio es explorar los factores que influyen en la integración del uso de herramientas de dibujo de inteligencia artificial en la educación de arte y diseño en colegios y universidades. Para integrar la tecnología de IA en la educación de diseño de arte,

primero es necesario aclarar el efecto de la aplicación de la tecnología de IA en el proceso

educativo. A través de los métodos de revisión de literatura, estudio de casos y enseñanza práctica, analizamos el potencial y los factores influyentes de la aplicación de IA en la educación mediante la integración de los fundamentos teóricos de la enseñanza de arte y diseño con IA. Este estudio resume los efectos y las posibles deficiencias de la aplicación de la inteligencia artificial a partir del caso de las universidades en China y propone contramedidas correspondientes. Las conclusiones del estudio pueden proporcionar apoyo teórico y orientación práctica para la aplicación de la inteligencia artificial en la enseñanza del arte y el diseño.

Palabras clave

Herramientas de dibujo de inteligencia artificial, educación en arte y diseño, efectos de la aplicación, deficiencias y contramedida

1. Introduction

1.1. Contemporary art and design education: applications and challenges of artificial intelligence technologies

The philosophy of contemporary art and design education emphasizes the development of creative thinking, comprehensive analytical skills and practical skills. Such a teaching philosophy advocates active learning, teacher-led inquiry, and an open and flexible classroom environment. This trend requires

educators to focus on stimulating students' passion for creativity and independent thinking, as well as enhancing students' design expression, communication skills and originality through a variety of teaching resources and methods. Art and design are an art based on which the author should continue to explore the love of life, cultivate the creation of economic, technological, and humanities knowledge, in a honeycomb of integration and perception, and constantly absorb and integrate the knowledge of various disciplines. The design teaching system should collaborate with different professions, promoting multidisciplinary intertwined learning, so that college students have a constantly updated and progressive mode of thinking. (Li, 2019).

To effectively integrate AI technology into art and design education in higher education, it is first necessary to assess the effectiveness of its application in the design field, which is realized through case studies and practical lectures. Following this, it is important to identify the challenges and limitations that AI may encounter in educational practice and explore solutions based on theoretical research. Ultimately, the theory and practice of design education need to be explored in depth to develop appropriate teaching strategies and application models. These studies will provide a solid theoretical foundation and practical guidelines for the implementation of AI technologies in the field of art and design education in higher education.

1.2. Impact of the development of artificial intelligence technology on art and design education in colleges and universities

The intelligent search function of artificial intelligence (AI) technology provides students with more convenient and rich learning resources. By crawling and organizing the massive data on the Internet, teachers and students can access a variety of learning resources, including teaching videos, teaching materials and online courses, anytime and anywhere. These resources' richness and diversity offer

students a wider range of learning options and provide teachers with an array of teaching aids and references. (Yang et al., 2023). Nevertheless, AI technology development presents challenges and issues. Primarily, it is imperative that teachers possess the requisite skills and competencies in their utilization of AI technologies. They must be well-versed in AI principles and applications and be cognizant of current pedagogical trends and methodologies (Yang, 2022). In addition, teachers need to collaborate and interact effectively with Artificial Intelligence (AI) technologies so that they become part of the teaching and learning process rather than simply a substitute for a tool.

In addition, the application of Artificial Intelligence (AI) technology may also lead to students' dependence on traditional learning methods and loss of learning initiative. Because the intelligent search and personalized teaching functions of artificial intelligence (AI) technology can provide many learning

resources and guidance needed by students, this may lead to a gradual weakening of students' ability to learn and think independently (Atapattu et al., 2020). Teachers must exercise caution in their application of AI technologies to ensure the appropriate application of these tools by students, prioritizing students' initiative and critical thinking skills.

Table 1. Comparison of the characteristics of design thinking in the age of artificial intelligence. (Source: own design chart)

Variant	Traditional Design Thinking	Design Thinking in an Artificial Intelligence Environment
Timing	People - Problem Solving	Things-Smart Solutions
Space	Focus on reality (static)	Focus on the combination of reality and fiction (dynamic)
Relations	people and things	People - Intelligence - Things
Study	People are proactive	Object Proactive and passive

Note: This information has been obtained through the student practice. Source: own design chart

The rapid evolution of Artificial Intelligence (AI) technologies has significantly transformed the field of art and design teaching. As these technologies advance, their integration into art education is becoming increasingly integrated, and AI technologies are enabling art instructors and students with a wider array of diverse and tailored teaching tools and resources. First, AI's computer vision and natural language processing capabilities bring easier visual and verbal communication capabilities to art learners. Utilizing

image recognition and deep learning algorithms, instructors and students can engage in instant critique and improvement of visual works, which not only promotes creativity and aesthetic ability, but also increases students' confidence and engagement (Beseiso et al., 2021).

Second, AI's predictive analytics and personalized learning path recommendation systems allow teachers to customize instruction based on students' creative habits and learning needs. By comprehensively analyzing students' creative data and learning patterns, teachers can accurately assess students' artistic level and preferences, and design exclusive teaching content and methods accordingly. This individualized pedagogical approach not only enhances learning efficiency but also fosters students' creative passion and curiosity.

Furthermore, AI's sophisticated data retrieval capabilities facilitate students' access to an extensive array of art resources (Donthu et al., 2021; Dutt et al., 2022). However, advances in AI technology also bring specific challenges and problems. Art and design teachers need to acquire the necessary professional knowledge and skills when applying AI technology. They must develop a comprehensive grasp of the underlying principles and pedagogical applications of AI technology and stay abreast of current

advancements and educational strategies within educational domains (Chen et al., 2020). In addition, teachers need to learn to work effectively with AI technology to ensure that it plays an active role in the teaching and learning process, rather than simply replacing traditional teaching tools.

Table 2. Use of mind visualization tools by higher education teachers

	options	numbers	proportions
Utilization	Used in each lesson	8	8%
	regular use	38	38%
	occasional use	43	43%
	Largely unused	4	4%
	never used	7	7%

Note: This information has been obtained through the student practice. Source: own design chart

Regardless of the complexity of the task, whenever repetitive mechanical work can be replaced by artificial intelligence tools, the designer's value and impact will be greatly reduced, increasingly reliant on the application of AI technology for support. Educators must foster a mindset of continuous learning and adaptability among designers and learners and enhance their design proficiency through engagement with emerging technologies and knowledge (Yu & Yuan, 2021; Huang et al., 2020; Hwang & Tu, 2021).

Table 3. The current situation and transformation of the development of art and design education in colleges and universities in the era of artificial intelligence. (source: own design chart)

Art and Design Education development status and changes	Percentage
With a single training goal, pay more attention to training comprehensive talents	86.42%
Focus on teaching and pay more attention to the development of future society	93.71%
By focusing on the role of individuality, pay more attention to human-computer collaboration	79.80%
Pay more attention to the overall development of students	70.20%
Pay more attention to the integration of industry and education	91.40%

Note: This information has been obtained through the student practice. Source: own design chart

1.2 Current status of domestic and foreign research

1.2.1. Status of foreign research

In international academia, several scholars have started to focus on AI's role in art and design pedagogy within higher education, engaging in preliminary investigations and practical implementations. Some foreign studies focus on the development and application of AI drawing tools. For example, Lee (2021) developed an AI-based drawing tool aimed at providing more design options and innovative ideas. Their study shows that this tool can effectively improve the creativity and efficiency of designers. Various researchers have examined the educational benefits of AI-based drawing tools. For instance, a study by Brown and Miller (2018) assessed these tools' impact on secondary education and concluded that students significantly improved in their creative, problem-solving, and collaborative abilities utilizing the tool in a design curriculum (Lin & Mubarak, 2021).

In addition, there are some studies focusing on the strategies and methods of applying AI drawing tools in design education. For example, Johnson and Smith (2019) proposed a teaching model based on the principles of learning theory and educational psychology that promotes students' learning interest and initiative by guiding them to use AI drawing tools for art and design practice (Roll et al., 2011; Sinclair et al., 2021). Within the context of art and design educational settings in higher education, scholars globally are broadening AI's application within design pedagogical and have conducted initial investigations and practical implementations. The new characteristics of the cognitive law of learners in the age of intelligence need to be supported by large-scale and long-time basic data research in order to elucidate the diversified features that have gradually appeared in different disciplines, different school segments, and different regions, which can be carried by short-term observation and small-sample research (Tong et al., 2022). In Falk Uebernickel's book *Innovative Thinking: Stanford Design Thinking Methods and Tools*, it is stated that design thinking is an increasingly popular approach to innovation that creates a constant stream of innovations that go beyond traditional products, services, and business models by changing mindsets and creating a customer-centered perspective. Scholars have also examined their educational impact within art and design curricula (Nasseri, 2021).

It was found that when students applied AI drawing tools in the design learning process, they showed significant improvement in creativity, problem solving and teamwork. In addition, there are studies that point out strategies and methods for applying AI drawing tools in design education. Some researchers have proposed pedagogical models based on advanced learning theories and educational psychology to enhance students' motivation and self-motivation by inspiring them to use AI drawing tools for design practice. While research globally has yielded numerous findings regarding AI drawing tools in art and design pedagogy, challenges persist within the research, including inconsistency in evaluative criteria and

variability in instructional approaches. Therefore, it is necessary to learn from domestic and international experiences, to study the key factors affecting the integration of AI drawing tools into design education, and to put forward corresponding solution strategies to promote the progress of art and design education in China's colleges and universities.

1.2.2. Status of domestic research

As there is growing domestic research concerning the application of AIGC (Artificial Intelligence Generated Content) in art and design education, the academic community's emphasis on it is on the

ascent. The scholarly discourse extensively addresses the development of AI-assisted design pedagogy, incorporating AIGC tools within educational frameworks, as well as assessing the efficacy of AIGC instructional methods across various tiers. These studies have guiding value in recognizing the potential and limitations of AIGC application in art and design education in colleges and universities (Urteaga et al., 2020). Research on the AIGC teaching model focuses on creating personalized and adaptive education models by analyzing students' learning behaviors and needs.

Examples include intelligent teaching systems that automatically adjust course content and difficulty according to students' learning progress, a model that has shown positive results in practice in enhancing students' design skills and creative thinking. Meanwhile, there are also studies focusing on the development of AIGC-based design education assistance tools that use image recognition and natural language processing technologies to digitize students' design works and provide automated design improvement suggestions, greatly improving the convenience and efficiency of design teaching and enabling real-time feedback of guidance. Empirical studies have assessed AIGC's efficacy within higher education art and design curricula, identifying the advantages and limitations of AIGC utilization through examining factors including student learning and engagement. These assessments also offer empirical support for AIGC integration in educational settings and offer constructive guidance for technological refinement.

2.Theoretical Foundations

2.1 Overview of Artificial Intelligence

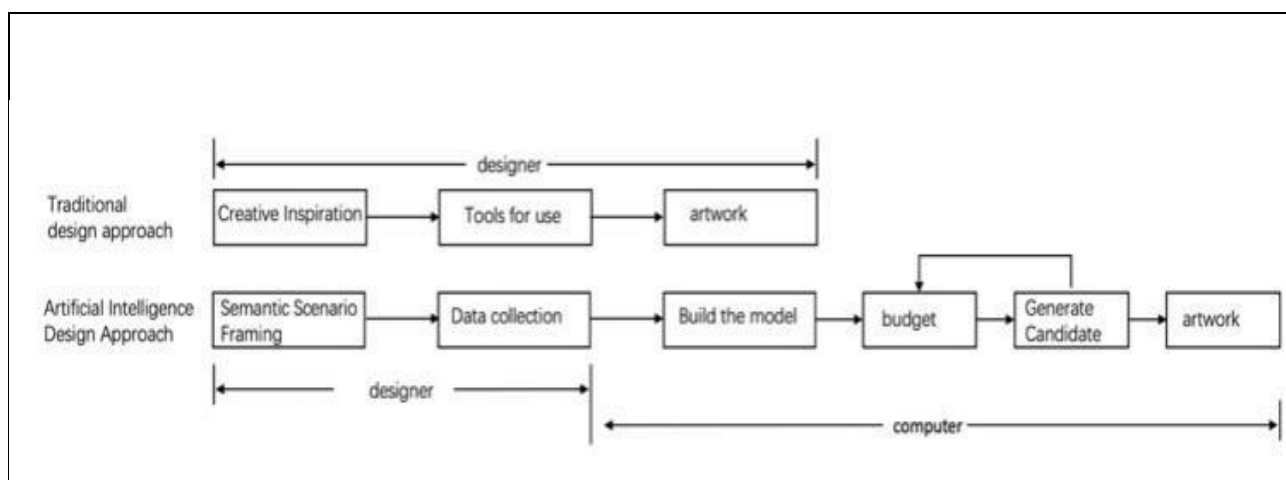
Artificial intelligence, a subfield within computer science, endeavors to equip computers with cognitive faculties akin to human intelligence (Van Eck & Waltman, 2010). It enables machines to think and act autonomously by simulating, extending or expanding human cognitive and decision-making processes. Artificial Intelligence utilizes algorithms and models to process and solve complex problems, resulting in

a wide range of applications in many fields (Wang et al., 2015). Artificial Intelligence research began in the 1950s, and with the rapid development of computer technology and theory, Artificial Intelligence has made great progress (Wu et al., 2013). The development of AI stems from the huge storage capacity and fast processing speed of computers, as well as the constant emergence of new machine learning algorithms and data mining technology. The introduction of artificial intelligence not only enables the efficient and convenient mining and analysis of data but also facilitates a more diverse range

of information transmission and real-time interaction, thereby rendering art design increasingly sophisticated while enhancing the user experience (Qin, 2020). The rise of Artificial Intelligence (AI) drawing tools is having a profound impact on art and design education in higher education, (Table 4) and such tools are embedded with advanced technology for AI-generated content (AIGC) (Zhai et al., 2021). They are revolutionizing the art and design field with their ability to mimic, augment and even surpass human design capabilities. For example, in illustration design, Midjourney can be used for a variety of purposes, such as inspiring creative projects, visualizing our ideas, exploring different scenarios or concepts, or just for fun. We can use it to quickly create landscapes, animals, objects, people, 3D models, or any image imaginable, and modify them with a variety of customization options and detail tools (Yang, 2022).

AIGC tools process large volumes of design data through sophisticated machine learning algorithms such as deep learning and neural networks, enabling them to understand design principles and aesthetic standards, but also to autonomously produce original and high-quality designs (Zhu et al., 2020).

Table 4. The difference between the division of labor between traditional design methods and AI design



Note: Source: own design chart

For example, deep learning algorithms allow AI systems to understand elements such as color palette, composition and style by observing and analyzing thousands of artworks. Subsequently, these systems can utilize the knowledge gained to create entirely new visual works.

A notable example is the DeepArt algorithm, capable of replicating the styles of masters such as Van Gogh or Picasso, transferring these styles onto any given photograph to create a unique work of art. In early 2022, OpenAI launched InstructGPT (Ouyang et al., 2022) based on GPT-3, and in November of the same year launched its cognate model ChatGPT, which has achieved more amazing progress in tasks such as text generation and natural language interaction. In education, AI drawing tools are being integrated into design courses, providing a new learning platform for students (Hwang et al., 2022).

Artificial intelligence drawing tools can further help students master the skills to analyze and deconstruct artwork and understand the underlying design principles. They can additionally generate customized design suggestions and templates tailored to students' design intent and style preferences. Not only does this expedite the learning process for students, but it also cultivates their personalized creativity. We should pay more attention to the students' use of AI tools in the teaching process, but we should not rely on the tools, or we lose our originality.

2.2 Characteristics of Artificial Intelligence

2.2.1. Natural Language Understanding

Among the many research areas of artificial intelligence technology, advances in natural language understanding have had a profound impact on art and design education in higher education. In particular, the development of AIGC tools has revolutionized art and design teaching. These tools can not only understand and simulate the complex process of art creation, but also generate visual works based on designers' initial ideas, greatly improving design efficiency and creative diversity. AIGC tools can generate high-quality images and visual elements through deep learning and neural network algorithms. For example, OpenAI's DALL-E system can generate unique image designs based on descriptions provided by the user. Products for image and video stylization have existed for some time, but they really took off when the originality Leon Gatys paper¹ brought the application of deep learning to this problem into the limelight. Some of the applications in this space have had a mobile focus (e.g. Prisma), while others have primarily focused on a web presence (e.g. DeepArt). In either case, the following applications deserve mention: Prisma (prisma-ai.com), Artisto (artisto.my.com), Painnt (moonlighting.io), Style (macdaddy.io/style), and finally DeepArt (depart.io), which is the productization of Gatys' paper (L.Gatys,A.Ecker,and M.Bethge,“A neural algorithm of artistic style,” Nature Communications, 2015; <https://arxiv.org/abs/1508.06576>; Agrawal, 2018).

In college art and design education, such tools not only act as educational tools enabling students to grasp design principles through examples but also enhance students' creativity and offer boundless sources of inspiration. In practical examples of art and design education in colleges and universities, the application of AIGC tools has shown that students can quickly transform abstract concepts into concrete visual representations by interacting with these intelligent systems. For example, students at a design school employed an AIGC tool for a project involving the creation of a series of themed posters. Students supplied keywords and design intent, where the AI system generated multiple design options for reference and modifications, significantly expanding the design possibilities and thereby producing high-quality work in a short period of time (Raffel et al., 2019). To fully utilize the potential of AIGC tools in art and design education in higher education, we still need to address some technical and pedagogical challenges. First, the AI system must be able to accurately capture and understand the designer's creative intent, which requires the system to have a high degree of semantic and contextual understanding. Second, designers and students need to acquire the skills to interact with AIGC tools, which means they need to have some technical knowledge and design theory foundation (Wei et al., 2022). Finally, to develop students' ability to think and create independently, educators need to design challenging courses and projects with the assistance of AIGC tools.

Figure 1. Student high quality work (2024). [Photography]



Note: Students produce high quality work in a short period of time. Source: images generated with MidJourney. Used with permission.

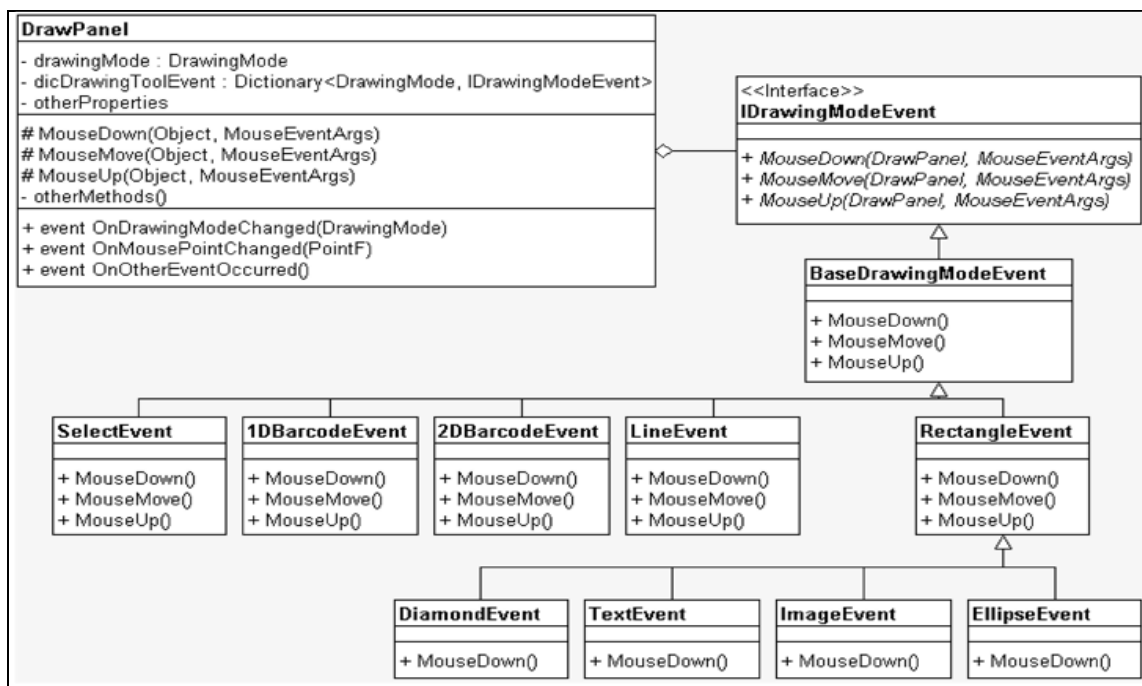
2.2.2. Machine learning

Machine learning, being a fundamental component of artificial intelligence technology, has been progressively penetrating the field of art and design education in colleges and universities, influencing

traditional methods of creation and instruction. A typical adaptive learning system consists of four parts: domain model, user model, teaching model, and adaptive engine, and representative systems include SQLTutor, AutoTutor, Why-2 Atlas, etc. In this period, intelligent teaching systems emphasize "learner-centeredness". Intelligent teaching systems in this period emphasize the concept of "learner-centeredness" and pay more attention to the learning needs and personality characteristics of learners (Li et al., 2018). AIGC tools utilize deep learning algorithms to train models to understand and simulate artistic styles and design languages to produce unique visual works.

There are numerous examples of the application of AI drawing tools in college art and design education. Taking the Central Academy of Fine Arts as an example, the institution explored the integration of AIGC technology into the curriculum, allowing students to utilize AI tools for creative practice in their design projects. Through the professor's explanations, students not only learned to use these advanced tools, but also deepened their understanding of design, especially in the areas of color theory, semiotics, and the use of visual elements, by generating works in collaboration with AI. However, while the application of AIGC technology in college art and design education brings many advantages, its challenges cannot be ignored. The training and optimization of models requires a large amount of data and resources while keeping the algorithms up to date to adapt to evolving art trends is also an ongoing task.

Tabla. 5. *Drawing tool event class design diagram*



Note: source own design chart.

Educators need to be technologically savvy enough to maintain and update AI tools and ensure that they can effectively complement teaching and learning activities. Therefore, educators themselves must first go on to become proficient in the use of AI tools. To address these challenges, several strategies are being proposed and implemented. First, data augmentation and transfer learning techniques can improve the effectiveness of model training with limited data and enhance the generalization ability of models. Second, art and design educators in higher education should continuously track the latest development of AIGC technology and regularly update and adjust their teaching tools to keep the teaching content current and relevant.

2.2.3. Intelligent Search

Artificial Intelligence Drawing Tools (AIGC) refers to the process of automating the creation of graphics, images and design elements through artificial intelligence technology. The application of this technology not only greatly enriches the expression of art and design but also brings innovative teaching methods and learning tools to the field of education (Roy & Dan, 2015).

In college art and design education, the use of AIGC tools enables students to break away from traditional creative constraints and explore broader design possibilities. Through AIGC tools, designers

can quickly generate many design solutions that are beyond the reach of human hands in terms of diversity and creativity (Adams et al., 2023). Currently, the models used in the education field include Xunfei Starfire, MathGPT, among others. These models are often fine-tuned by general-purpose Large Language Models (LLMs) using relevant pedagogical knowledge, which can assist students and teachers in improving the efficiency and quality of learning and teaching, enriching the content and form of education, as well as expanding the educational scenarios and objects, bringing new possibilities and opportunities to the field of education (Yan et al., 2023). For example, platforms such as DeepArt utilize deep learning algorithms that can generate unique artworks based on keywords or style requirements entered by users.

Students can learn how to integrate AI technology into their own design process and improve the efficiency and quality of their designs by interacting with these tools. While the traditional model of art and design education in colleges and universities tends to focus on the cultivation of manual skills and individual creativity, with the assistance of AIGC tools, students can focus more on design thinking and conceptual innovation. With the assistance of AI, some repetitive and technical tasks can be automated, thus freeing up more time and energy for students to study design theory and practical exploration (Tay et al., 2023). Changes in educational scenarios have triggered systematic changes, with the educational environment evolving from informatization to intelligence, the teaching content shifting

from static subject knowledge to dynamic and comprehensive tasks, the teaching mode shifting from teaching to learning, the learning mode expanding from interpersonal collaboration to human-technology collaboration, and the concept of educating people has shifted from knowledge-based to emphasizing more on "competence-oriented and value-oriented"(Yang et al., 2023). The introduction of AIGC tools has changed the structure of design courses in some advanced educational institutions, having shifted curricular content to emphasize design thinking, user experience, and interdisciplinary innovation. Furthermore, the application of AIGC tools in the field of art and design has been instrumental in facilitating the development of personalized instruction. Intelligent drawing tools can provide customized design advice and teaching resources based on each student's design style, preferences and progress (Devlin et al., 2019). This kind of personalized teaching greatly improves the relevance and effectiveness of learning. However, the widespread use of AIGC tools also brings challenges to art and design education in higher education. Design educators need to re-examine course content and teaching methods to ensure that students can master the new tools without losing their understanding and application of design fundamentals (Deng et al., 2009). How do you strike a

balance between the use of technology and the development of creativity? The authors argue that the use of tools cannot be taught alone at the expense of creativity development.

2.3. Interrelationship between Artificial Intelligence and Art and Design Teaching in Colleges and Universities

With the leapfrog development of artificial intelligence technology, its application in the field of art and design education in colleges and universities is gradually showing a subversive impact. Different from the traditional art design teaching mode, the emergence of AI drawing tools has brought brand new teaching resources and methods to college art design education, greatly enriching the teaching content and means (Hoffer & Ailon, 2015). Artificial Intelligence (AI) drawing tools, such as Adobe Sensei, Deep Art, and so on, through deep learning and neural network technology, can imitate and learn the drawing styles of art masters, offering a new platform for learning and creation for art design students. For example, a unified framework called DeepArt is designed to learn joint representations that can simultaneously capture the content and style of visual arts.

This framework, which learns unique characteristics of visual arts directly from a large-scale dataset, is more flexible and accurate than traditional handcrafted approaches (Mao et al., 2017). [40] These tools can analyze and understand aesthetic elements such as color, composition, light and shadow, and then assist students to achieve personalized and innovative expression in design creation. The application of artificial intelligence drawing tools has transformed art design teaching from a single transfer of skills to

one that pays more attention to the cultivation of creativity and innovation. By learning and simulating the styles of historical art works, students can understand more deeply the evolution of art styles and the characteristics of different art genres, so that they can use these elements more freely in design practice. In actual teaching, artificial intelligence drawing tools have been proven to improve students' design efficiency and design quality.

Figure 2. Image of a restaurant made with IA assistance. (2024)



Note: NVIDIA is using machine learning for denoising rendered images. Source: NVIDIA.

Art and design education in colleges and universities should reasonably integrate artificial intelligence technology while maintaining artistic creativity to achieve the perfect integration of technology and art. The development of artificial intelligence drawing tools has had a profound impact on college and university art design education. It not only promotes the innovation of teaching methods but also lays a solid foundation for cultivating art and design talents with highly innovative and practical abilities.

3. Analysis of the Application of Artificial Intelligence in Art and Design Teaching in Colleges and Universities

The application of artificial intelligence technology in the field of art and design education in colleges and universities shows great potential and diverse functionality. For example, through the introduction of intelligent systems, students can obtain tailored learning paths (Li & Wang, 2004). The effectiveness of AI in education is primarily contingent upon interactive communication, that is, the interactions between learners and AI systems. The contextual framework of AI educational applications

encompasses two primary elements: individuals and technological tools, serving as collaborators, instructors, and administrators, as well as auxiliary tools and supportive environments (Quan et al., 2021). From the perspective of teaching effectiveness, traditional education depends more on the quality of the teacher, including academic level, teaching experience, and even the teacher's personality and talent, etc. The student's situation is diverse and complex, and the teacher's energy is limited, so it

is not easy to teach according to the student's ability. teachers can use artificial intelligence as an auxiliary tool to improve the accuracy of tailoring teaching to students' needs (Manjunath & Ma, 1996). Art and design education in colleges and universities places a premium on creativity and individual expression, where AI can offer customized projects, tutorials, and feedback tailored to students' interests, abilities, and learning progress, thereby significantly improving learning effectiveness (Luckin & Holmes, 2022).

Through in-depth analysis of students' works, students' design preferences and potentials can be discovered, so that targeted guidance and advice can be given. Further, AI can provide art and design students with a vast array of resources and advanced tools. In the digital age, design resources and tools are increasingly abundant, but they also create information overload. Artificial intelligence, through intelligent filtering and recommendation engines, can recommend the most appropriate and highest quality materials and tools to students based on their learning history and preferences. For example, intelligent image libraries can help students find inspiration, while algorithm-driven design software can assist students in making decisions on complex design tasks. The use of AI is also revolutionary when it comes to assessment and feedback. While traditional assessments are often time-consuming and subjective, AI technology can monitor students' learning and creative processes in real time, using machine learning and natural language processing techniques to automatically grade and provide feedback on students' design assignments (Sdenka & Salas, 2020).

Artificial intelligence can help teachers efficiently find the most relevant teaching resources and cases through intelligent algorithms and database systems, reducing their workload. In this way, teachers can focus more on teaching and personalized guidance for students. Integration of AI within higher education art and design curricula encompasses a wide range of applications and holds transformative potential. It can significantly improve students' learning experiences and outcomes, while also equipping educators with effective instructional tools. Nevertheless, AI integration confronts ongoing challenges, including data privacy, technological expenses, and the advancement of educators' professional skills.

3.1 Prerequisites for the Application of Artificial Intelligence in Art and Design Teaching in Colleges and Universities

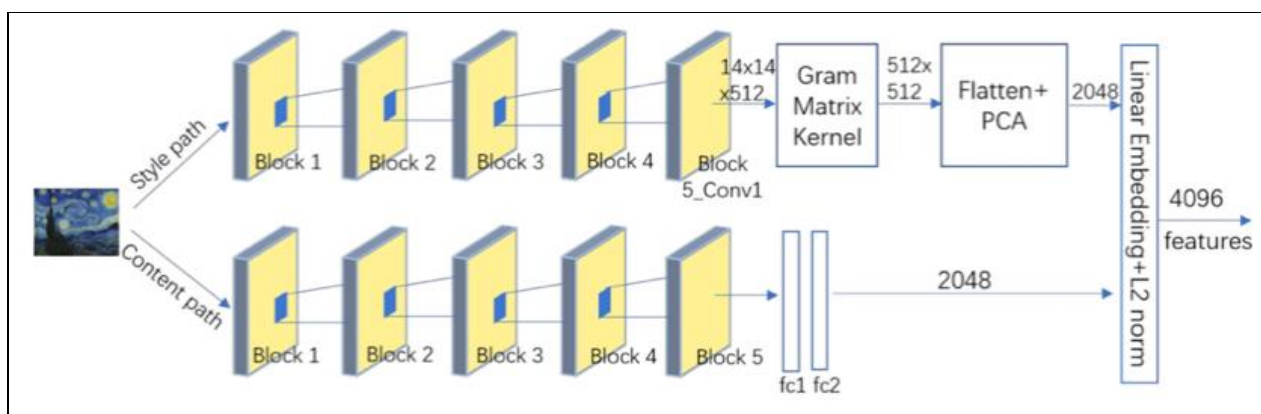
3.1.1. Teaching objectives of art design in colleges and universities

In modern art and design education in colleges and universities, the teaching objectives are to cultivate students' creativity, critical thinking and professional skills in the fields of visual communication, environmental art, product design and digital media. To achieve these goals, the incorporation of Artificial Intelligence (AI) technology provides unprecedented teaching methods and approaches. However, to effectively integrate AI into art and design programs, several prerequisites must be met to ensure the quality of education and the overall improvement of students' abilities. First, universities must have adequate technological infrastructure, including high-speed network connections, AI software platforms, computing resources and specialized hardware equipment. This is because high-quality art and design works often require a large amount of data processing and graphic rendering capabilities, and only when these infrastructures are in place can AI applications proceed smoothly. Specialized equipment is required to do some special data processing, which is usually done in a laboratory. Secondly, the professionalization of the teaching staff needs to be improved, and they should have a dual background of AI knowledge and professional skills in art and design. Teachers not only need to guide students on how to use AI tools for design creation but also help them understand the principles behind AI technology, cultivate students' critical thinking, and prevent over-reliance on technology and neglect of the essence of art design (McCarthy et al., 2006).

Again, the curriculum design should be closely integrated with the characteristics of AI technology to deepen the teaching content. For example, AI-assisted data analysis can help students master the methods of market research and user research, and then accurately locate user needs in product design. In visual communication courses, AI can analyze many visual elements and assist students in making more creative and scientifically based decisions in layout design and color matching. Practical applications exemplify the fusion of theoretical concepts with technological advancements. Within the realm of digital media, leveraging AI generative algorithms, students are enabled to craft innovative moving images and video compositions. For instance, the DeepArt platform, capable of analyzing an artist's stylistic nuances and applying them to any photograph, serves as a conduit for students to delve into the burgeoning domain of digital art.

It contains dual paths that can extract style feature and content feature respectively. The five convolutional blocks in the network are the same as VGG-16. Meaningful weights of the framework can be learned via appropriate learning methods. The number shown on the top of an arrow is the size of the output feature (Mao et al., 2017).

Figure 3. The architecture of DeepArt framework.



Note: It contains dual paths that can extract style feature and content feature respectively. The five convolutional blocks in the network are the same as VGG-16. Meaningful weights of the framework can be learned via appropriate learning methods. The number shown on the top of an arrow is the size of the output feature. Source: DeepArt: Learning Joint Representations of Visual Arts.

3.1.2. Hardware devices

AI hardware equipment must have efficient graphics processing capabilities and large storage capacity. In order to adapt to the special needs of art and design education in colleges and universities, so that high-quality images and design files can be quickly processed and stored. Such hardware usually includes workstations equipped with professional graphics processing cards, high-performance servers, and platforms that utilize cloud computing technology to ensure that art design software and applications can run smoothly. Meanwhile, a stable network connection is equally crucial for accessing online resources and collaborating remotely (Russell & Norvig, 2009). AI hardware for art and design education in colleges and universities should also support rich input and output interfaces to accommodate diverse creation and interaction needs. For example, systems equipped with touch screens, digital boards, 3D scanners, and augmented reality (AR) or virtual reality (VR) devices can enable students to interact with the AI system through drawing, scanning, or immersive experiences, thus enhancing the intuitive and interactive nature of creation. The ability for multiple users to operate in parallel is also necessary to facilitate pedagogical models that cater to group creation and critique. Another key factor in ensuring effective operation of AI hardware devices is the availability of technical

support and maintenance services. And relevant professionals need to be available for maintenance. Routine system upgrades and maintenance are prerequisites for maintaining system stability and security, while fast-responding online technical support and problem-solving services are effective in

minimizing pedagogical interruptions. In responding to the above hardware requirements, colleges and universities can consider cooperating with technology companies or hardware suppliers to introduce the latest AI equipment and customize hardware configurations according to the actual needs of art and design education in colleges and universities (Rahwan et al., 2019). Art design teaching assisted by AI can significantly improve the quality and efficiency of students' creations. For example, in its visual communication design course, the China Academy of Art, through the configuration of high-performance computers and software with AI-assisted functions, students can automatically match colors and layouts when designing posters, which significantly improves the professional level of design.

3.1.3. Technical requirements

Technical conditions, including required hardware equipment and software platforms, are the basis for supporting the effective integration of AI drawing tools into college art and design education programs (Dunn & Mulvenon, 2009). [50] This research concludes that adequate and efficient technical conditions are crucial for the effective integration of AI drawing tools in educational practices. The objectives of art and design curricula in higher education institutions encompass fostering students' creativity, design competencies, and technological proficiency (Zeng & Wang, 2017). The introduction of AI drawing tools is intended to facilitate the enhancement of students' abilities in these areas. The need for hardware is not limited to computers and tablets, but extends to specialized graphics processors, high-resolution monitors, and high-speed Internet connections.

Students need to interact with AI drawing tools through these advanced devices as a means of design creation and visual expression. Therefore, ensuring adequate and high-performance hardware resources on campus becomes a prerequisite for meeting teaching and learning needs. Software support, as another key part of the technical conditions, is also crucial for the effective use of AI drawing tools. Software platforms used in college art and design courses should have user-friendly interfaces, diverse functional options, and intuitive operating procedures so that students and teachers can practice design without barriers. In addition, the compatibility and stability of the software is also an important consideration to ensure that the AI drawing tools can run smoothly under diverse operating

systems and hardware environments and provide immediate technical support and update services.

Robust technical infrastructure, including stable network connectivity, ample bandwidth, and robust data storage capabilities, forms the foundation for the effective application of AI drawing tools in college art and design education. For instance, students may need to collaborate on designs remotely via cloud services, requiring a network environment that supports their seamless creative activities at any time and place. At the same time, the large volume of student work generated needs to be securely stored and easily managed, so an efficient data storage solution is also essential. To ensure that the technological conditions can meet the needs of art and design education in higher education, schools and educational administrations should strengthen their investment in technological facilities and software platforms. In specific cases, like Stanford University's design school is a good example of art and design education in colleges and universities, which provides a series of high-quality AI drawing tools, as well as matching technical facilities and software platforms, for the use of tools, thus greatly facilitating the cultivation of design thinking and innovation ability.

3.2. Design of Art and Design Teaching System in Colleges and Universities Based on Artificial Intelligence.

In the current study, we focus on the design elements of a teaching system for art and design education in colleges and universities that incorporates artificial intelligence technology. The purpose of the study is to assess the effectiveness of AI tools in the field of art and design education; to uncover the challenges it faces in the teaching process, and to propose corresponding solution strategies for these problems. To gain a comprehensive understanding of the issue, this study used a variety of research methods, including literature review, case study, and empirical pedagogy, to analyze in depth the impact and potential of artificial intelligence on art and design education in higher education (Crawford & Calo, 2016).

Within the realm of educational system design, a system that is scientific, rational, and efficient is essential for incorporating AI into art and design pedagogy. It is imperative to initially define the pedagogical goals for art and design within higher education (Perry & Perry, 2015). These objectives usually include cultivating students' innovative design ability, aesthetic and art appreciation, and professional practice skills. When building an AI-based art and design teaching system, we must translate these teaching goals into the design requirements of the system functions and ensure that

they can be fully realized. The equipment of hardware facilities is the basis for the application of artificial intelligence in art and design education. Colleges and universities need to be equipped with advanced computer equipment, professional graphic processing workstations, interactive projection equipment, etc., so that teachers and students can efficiently use AI tools for teaching and creation. In addition, the support of software and network technology is equally important.

Only when the campus has powerful software resources and a stable network environment, the interaction between teachers and students and the sharing of information can be carried out smoothly (Mohr, 2019). In terms of technical conditions, we also need to consider the functional design and user

interface design of the teaching system. The functional design of the teaching system needs to fully consider the teaching needs of teachers, the learning needs of students and the characteristics of the art and design discipline. The system should empower educators to conduct a variety of teaching activities, including theoretical lectures, practical exercises, innovation, and practice, while also accommodating the needs of students for independent learning, collaborative learning, and project-based activities. At the same time, the user interface design should be simple, intuitive and easy to operate to improve the user experience of the whole system. Based on the above requirements, we propose an artificial intelligence teaching system design and implementation program for art and design education in colleges and universities. [55] This process covers in detail the requirements research, functional planning, interface layout, deployment and implementation, and effect evaluation of the teaching system.

4. Conclusion

Throughout this investigation into factors impacting the adoption of AI tools within design pedagogy, we have discovered AI's potential and the efficacy of its application in higher education art and design instruction. Nevertheless, challenges and limitations remain that require further exploration within subsequent inquiry and application. We need to pay attention to the development and update of AI technology. With the continuous development and innovation of AI technology, the drawing tools in it will also be further improved. Therefore, in the future, we need to continuously pay attention to and study the latest development of AI mapping tools, and update and optimize our instructional design in a timely manner.

Furthermore, attention must also be given to the viability and enduring impact of AI within higher education art and design. Regarding this matter, a multitude of factors must be considered, encompassing hardware upgrades and replacements, technical enhancements and system optimization, as well as fostering educator proficiency and facilitating student acclimation. Only after these aspects have been effectively addressed can AI truly realize its potential and effectiveness in art and design teaching in colleges and universities. This requires in-depth cooperation and communication with relevant parties such as pedagogy, teachers, students and parents. Only through the cooperation and joint efforts of many parties can artificial intelligence be integrated into the concept and practice of design education and promote the innovation and development of art design teaching in colleges and universities.

In addition, this study explores and analyzes the effects of the application of AI drawing tools in design education, but the factors affecting the use of AI drawing tools to integrate into design education have still not been studied. There are still shortcomings in terms of methodological limitations, limitations in sample size and scope, factors that have not been studied, and validation of the effectiveness of countermeasures. Future research could continue to explore these factors, including teachers' and students' attitudes and acceptance, and the level of support from teaching environments and resources, to gain a more comprehensive understanding of the use of AI drawing tools in design education. Future research could conduct laboratory or field empirical studies to verify the effectiveness of the proposed countermeasures in actual teaching. To provide more comprehensive and effective support and guidance for the application of AI in art and design teaching in colleges and universities.

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