Exploration of the Applications of Image-based AIGC in Art Education

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Abstract. With the rise of generative artificial intelligence (AIGC), the art and design industry is undergoing a transformation, presenting new challenges for the education and training of students in the field of art and design. This paper aims to analyze the impact of AIGC on the field of art and design, compare the differences between AIGC and traditional art creation methods, and provide a review and analysis of current representative image-based AIGC systems. Furthermore, it explores the potential applications of AIGC technology in art education and proposes how the educational model for art and design should be optimized in the context of the AI era.

Keywords: artificial intelligence; AIGC educational applications; art and design; optimization of educational models.

1. Introduction

The rise of Artificial Intelligence Generated Content (AIGC) is profoundly influencing the art and design industry, introducing new perspectives and tools to traditional art and design creation while demonstrating considerable potential. Artists and designers can now realize their ideas and create works more efficiently, yet they also face a series of new challenges. Art and design education in schools must acknowledge this shift, adapt educational philosophies and models, and implement comprehensive teaching reforms to cultivate students' interdisciplinary integration capabilities, comprehensive aesthetic literacy, and deep understanding of AIGC technology. This paper analyzes the differences between AIGC and traditional art and design creation, explores the impact of AIGC on the art and design industry, reviews current popular and mature image-based AIGC systems, investigates the specific applications of these systems in art education, and proposes strategies for optimizing art and design education models in the context of the AI era.

1.1 Overview of Image-based AIGC Systems

In the field of painting, the generation of artworks based on computer technology did not emerge overnight. Its history can be traced back to the 1970s, when American artist Harold Cohen pioneered algorithmic art by employing the AARON program to generate paintings through the control of a robotic arm. In the 1980s, artists began using human-computer interaction techniques to create interactive experiences for audiences. Moving into the 2000s, artists started employing coding tools such as Processing and Open Frameworks for artistic creation.

Since 2015, the rapid advancement of deep learning technology has significantly propelled the iterative development of generative art. Convolutional neural networks (CNNs) have started to comprehend visual images in novel ways, facilitating neural style transfer and thereby enabling the fusion of different image styles to create new artworks. In 2018, AI-produced portrait "Edmund Bellamy of the Bellamy Family" made its debut in auctions. By 2019, with the gradual maturation of generative adversarial network (GAN) technology, AIGC reached a pivotal turning point.

In 2011, OpenAI introduced DALL-E. Both ChatGPT and DALL-E are models developed by the company. DALL-E employs a deep neural network based on the GPT (Generative Pre-trained Transformer) architecture. Specifically, it uses a variant of the autoregressive transformer model, similar to the GPT model. This model consists of multiple layers of self-attention mechanisms and

feedforward neural networks, designed to process input text descriptions and generate corresponding images.

The interface of DALL-E is essentially the same as that of ChatGPT, but it can generate images that match given text descriptions and allow for modifications to the generated images through chat dialogues. However, DALL-E is not a fully open model, and detailed information regarding its specifics and architecture has not been publicly released. Therefore, we can only approximate its basic structure based on descriptions provided by OpenAI.

DALL-E has now been updated through several versions, with the latest iteration featuring a seed-controlled image generation function that significantly enhances the consistency of generated outputs. When users generate images, they can request GPT to return the seed value of the image. If modifications are needed later, users only need to specify the seed value to adjust the prompts accordingly.

Novel AI's training data heavily originates from Danbooru, a image search and sharing website primarily featuring images from Japanese animation, manga, and games. This gives it a significant advantage in achieving a "2D" effect. It shares its basis with engines such as Lexica, all grounded in the Stable Diffusion model. Lexica is particularly focused on being a prompt search engine for the Stable Diffusion model, integrating search, drawing, and keywords into a unified AI drawing tool. Users can edit prompts for images and generate new ones. In the "Negative prompt" box, users can specify content they do not want in the image, select image dimensions in "Dimensions" and in "Advanced options",they can select the model version to adjust different styles. Uploading an image allows for layered image generation. For general users, a free account can be selected, allowing for the generation of up to 100 images per month, with additional options available through subscription.

Midjourney, based on a Discord community cloud-based imaging tool, also employs a language model similar to GPT (Generative Pre-trained Transformer). Users initiate the "/imagine" command with a prompt, prompting the bot to return four images. Users can select one or more images for further processing or generate additional layered images. It is a mature and robust AI image editing and generation tool. Its community-oriented server features allow users to produce content in a community-driven, networked learning fashion. However, the current free trial has been suspended, requiring payment for use.

Stable Diffusion, developed by Stability AI, is a locally deployed and completely open-source free tool. It allows for fine-tuning images and customization, solving productivity problems, but requiring higher GPU demands, complex installation, and a steeper learning curve. It is more suitable for users who prefer greater image control and enjoy researching and applying AI in practical projects.

Although the aforementioned tools are all AI image generation tools with similar interaction methods, each has its own strengths. In the field of art, they no longer compete on the same track. Domestic companies such as Baidu, Alibaba, and SenseTime in China have begun to lay out AI art platforms like Wenshen Yige and Dreamweaver, with WeChat Mini Program Yijian AI also having its moment. Figure 1 summarizes the current popular image-based AIGC systems discussed above.

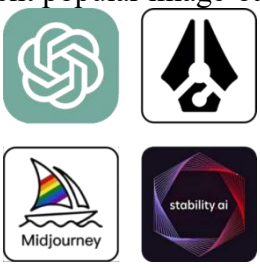

Fig.1 Popular Image-based AI Systems

2. Differences Between AIGC and Traditional Artistic Creation Processes

The traditional artistic creation process can be summarized as follows:Inspiration Gathering: Artists gain creative inspiration through observation, reflection, or emotional experiences. Conceptual Design: Artists develop initial ideas for their work, which may include sketches or conceptual drawings.Material Preparation: Artists gather necessary materials and tools according to the requirements of their work.Creation Implementation: Artists begin the actual creative process, which may involve painting, sculpting, photography, etc.Modification and Refinement: Artists continuously revise and refine their work during the creation process.Exhibition and Communication: Upon completion, artists exhibit their work and engage in discussions with other artists or audiences.Evaluation and Feedback: Artworks receive evaluation and feedback from audiences and critics. Depending on the owner's decision, the final artwork may be displayed, promoted, or traded. Most artworks require appropriate preservation measures to ensure their integrity and longevity.In contrast, the creation process of AIGC reflects a novel approach to artistic creation, complementing traditional methods with data-driven algorithms.

The process of AIGC artistic creation can be summarized as follows:Data Input: Training AI models by inputting large amounts of artistic data.Algorithm Design: Designing and selecting algorithms and models suitable for artistic creation.Style Learning: AI learns and imitates specific artistic styles or techniques.Parameter Setting: Setting creative parameters such as colors, shapes, composition, etc.Automatic Generation: AI autonomously generates artistic works based on set parameters and learned styles.Human Review: Human artists or designers review AI-generated works and make necessary adjustments.Exhibition and Communication: Sharing AI-created artworks with audiences and receiving feedback.Iterative Optimization: Continuously iterating and optimizing AI models based on feedback.

Comparing these two types of artistic creation processes, the primary differences lie in the role of the creator. In traditional artistic creation, humans are the primary creators, while in AIGC artistic creation, AI takes on the role of generating works, with humans primarily involved in design and review. AIGC tends to produce artworks more rapidly and in larger quantities compared to traditional methods. In terms of creative scope, AIGC can explore a wider range of styles and forms, unrestricted by the physiological and psychological limitations of human artists. However, the fundamental differences lie in creativity and personalization. Traditional creation often exhibits strong personalized characteristics derived from an artist's personal experiences and emotions, whereas AI-generated works may initially lack this personal touch, although efforts can be made to train AI models for specific styles. Creativity in traditional creation originates from the artist's individuality, while AI creation derives from algorithms and data. Additionally, from a technological dependency perspective, AIGC heavily relies on advanced technologies and algorithms, whereas traditional artistic creation relies more on an artist's skills and creativity.

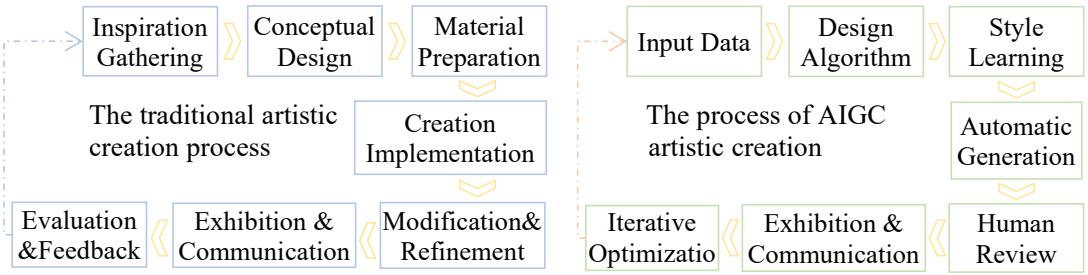

Figure 2: Comparison of Two Types of Artistic Creation Processes

3. Impact of AIGC on the Arts and Design Industries

Artificial Intelligence Generated Content (AIGC) technology has revolutionized the arts and design industries, bringing about profound changes. It has not only enhanced creative efficiency[1]

and reduced costs but also diversified artistic styles, enabling personalized customization. AI's involvement has catalyzed industry innovation, inspiring human artists' creativity[2], and fostering the emergence of new artistic forms. In the realm of education, AIGC serves as a teaching tool, aiding students in mastering the principles and techniques of art and design more rapidly. It challenges traditional notions of artistic value, sparking debates on the roles of humans and machines in artistic creation. AI can introduce interactive elements into artworks, allowing them to self-adjust and evolve based on audience feedback. Moreover, AI enables art and design decisions to be informed by data analysis, facilitating easier market entry and broadening commercial applications in the arts and design sectors. This increases the market adaptability and success rate of artworks. AIGC promotes interdisciplinary collaboration across art, design, technology, and business, providing new platforms for innovation. Furthermore, it contributes to sustainability in the arts and design industries by reducing the use of physical materials and supporting sustainable development initiatives.

4. Application of Image-based AIGC in Art Education

Innovative Teaching Tool: Image-based AIGC technology can create realistic artworks that serve as educational tools, aiding students in understanding various art styles and techniques. For example, AI can generate artworks spanning from the Renaissance to modern art styles, which educators can use to teach art history. Through intuitive comparisons facilitated by these artworks, students can grasp the distinctive artistic characteristics of different periods. AI's capability to recreate historical artworks offers novel perspectives for art historical education. Students can deepen their understanding of various art movements such as the impressionist play of light and shadow or the geometric forms of cubism through AI-generated works, thereby enhancing their comprehension of art history and theory.

Personalized Learning Experience: AI can generate personalized artistic content based on students' learning interests and proficiency levels. By analyzing students' learning behaviors[3], AI can provide tailored learning materials such as exercises in specific art styles or demonstrations of advanced techniques, thereby meeting the personalized needs of diverse learners effectively.

Artistic Creation Assistance: When students face creative blocks or technical challenges during artistic creation, AIGC can function as a creative assistant. It can provide inspirational images or simulate various artistic effects to help students overcome creative barriers and enhance the expressive quality of their works. Moreover, AIGC can conduct detailed analyses of artworks, offering guidance on aspects like color combinations, composition layouts, and thematic expressions, while also contributing to the development of students' aesthetic abilities and critical thinking.

Virtual Art Exhibitions: Utilizing AIGC technology, virtual art exhibition spaces[4][5] can be created, allowing students to appreciate artworks in an environment free from physical constraints. This approach expands students' artistic horizons by showcasing artworks from around the world, including immobile public art pieces.

Visualization of Abstract Concepts: Art theory encompasses numerous abstract concepts. AIGC can transform these concepts into visual images, assisting students in better understanding and retention. For instance, presenting the evolution of art movements through dynamic visualizations enhances the effectiveness and engagement of learning[6].

Integration of Interdisciplinary Knowledge: AIGC promotes the integration of art with other disciplines. For example, in programming courses, students can utilize AIGC to design game characters, animations, or user interfaces[1], thereby integrating artistic creation with programming skills. This interdisciplinary approach fosters students' innovation and comprehensive application abilities.

In conclusion, the application of image-based AIGC in art education not only enhances traditional teaching methods but also empowers students to explore diverse artistic expressions,

deepen their understanding of art history and theory, and cultivate essential skills for future creativity and innovation.

5. Optimization Strategies for School Art and Design Education in the Era of AIGC

5.1 Integration of AIGC Technology into the Curriculum

Integrating AIGC technology into art and design courses necessitates updating existing curricula[7] to incorporate theoretical and practical teachings on AI-generated art. Students need to grasp the fundamental principles of AIGC, including machine learning and deep learning, and learn to operate AIGC software tools effectively. Teachers should provide theoretical guidance to help students understand the workings of AIGC technology and how to integrate AI techniques efficiently into their design processes. The curriculum should include case studies analyzing AI's applications in art and the creative processes and critiques of AI-generated artworks.

5.2 Strengthening Creative Thinking and AI Collaboration

In the era of AIGC, cultivating creative thinking involves not only emphasizing originality and imagination but also teaching students how to collaborate with AI technology as a creative tool. This entails instructing students on guiding AI in creative processes, extracting inspiration from AI-generated content, and integrating it into their own artistic designs. Students explore various aspects of art and design such as color combinations and composition through practical applications while learning how to apply theoretical knowledge.

Educators must design activities and exercises that encourage students to explore how AI technology can expand their creative boundaries while maintaining human creativity and expressive abilities. Emphasizing human-machine collaboration means educating students on effective communication and cooperation with AI systems. Students need to learn how to clearly articulate their creative intentions to AI systems and understand and utilize design suggestions provided by AI systems. Additionally, students should learn how to evaluate and select AI-generated design works and integrate them with their own creative ideas to produce unique artistic designs.

5.3 Interdisciplinary Education Integration

The integration of art and design with disciplines like computer science and data science provides students with broader perspectives and diverse thinking approaches. Through interdisciplinary courses, students not only learn the fundamental principles and techniques of art and design but also acquire technical skills in programming, data analysis, and beyond. This fusion helps students understand the scientific principles behind AIGC technology, enhances their problem-solving abilities, and prepares them to adapt to dynamic work environments in their future careers.

5.4 Critical Thinking

Developing students' critical thinking abilities enhances their awareness of independent thinking and the evaluation of information's authenticity and reliability. AI-generated content is not inherently flawless or accurate in all contexts. Students need to learn to assess AI-generated artworks from multiple dimensions, including creativity, aesthetics, and technical aspects.

5.5 Balance Between Art and Technology

While emphasizing technological applications, it's crucial to ensure that the core values of art and design education are not overlooked. Finding a balance between art and technology[1] involves utilizing AI technology to enhance design efficiency and innovation while nurturing students' artistic perception, creativity, and fundamental artistic skills. Encouraging students to explore the

intersection of art and technology helps them create works that combine technical prowess with artistic beauty, maintaining the essence of both technological application and artistic creation and avoiding overreliance on AI technology.

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