

A Study on Teaching Modes of AI-assisted Design Courses from the Perspective of the Metaverse

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Abstract:

By reviewing the development of modern artificial intelligence and the application of OpenAI's DALL-E model in the design field, this paper analyzes the interdisciplinary crossover of artificial intelligence and design professions in the era of smart interconnectivity. Using AI-assisted design courses from universities at home and abroad as case studies, the relationship between the courses and the metaverse is explored, and the exploration and practice of teaching modes are unfolded. This includes the introduction of the latest tools and software, adopting the STEM teaching method, and emphasizing education on ethics and law. Through case studies, the application of AI-assisted design courses in areas such as virtual humans, human-computer interaction, and painting and design is demonstrated. The aim is to provide theoretical and practical guidance for AI-assisted design courses, promoting the integration of design education and technological innovation.

Keywords:

Metaverse, AI-Assisted Design, Teaching Model, Design Education, Interdisciplinary Intersection

1. Introduction

The origins of artificial intelligence can be traced back to 1921 when Karel Capek's play "Rossum's Universal Robots" first appeared on stage. Although the term "artificial intelligence" did not exist then, the play not only introduced the concept of "robot" but also brought the concept of AI into popular culture. The meteoric rise of intelligent technology has swept across industries, with the design sector bathed in this magnificent force. Building on traditional design, AI-assisted design provides designers with novel creative tools and methods, prompting a shift in design education and practice.

2. History and Development of AI-Assisted Design

2.1. Three waves of AI development

2.1.1. Symbolic Reasoning Era: Focus on granting machines logical reasoning capabilities

During the first wave (1956-1974), AI research concentrated on reasoning and logical inference. Early AI systems employed symbols and rules to address issues, mimicking human thought processes. These systems depended on expert knowledge bases and rule sets, utilizing symbolic operations and logical reasoning to solve problems. However, due to the limitations of symbolic reasoning methods, as well as computer power constraints and government funding pressures, AI research hit a downturn.

2.1.2. Statistical Learning Era: Concentrated on the practicality of expert systems

With the increase in computational capacity and data volume, AI entered its second wave (1980-1987), the statistical learning era. During this period, machine learning algorithms became widely adopted, enabling designers to use vast amounts of data to train models and gain insights and creativity. Expert systems, reliant on knowledge base systems and knowledge engineering, were a significant breakthrough at the time, granting AI practical application capabilities in specific domains. However, the development of expert systems was hindered by challenges like difficult upgrades and high maintenance costs, leading to another bottleneck in industry progress.

2.1.3. Deep Learning Era: Represented by deep learning, perceptual intelligence matures

With massive advancements in deep learning technology, AI entered its third wave (from 1993 to the present) – the era of deep learning. Deep learning models, with their multi-layered neural structures, comprehend complex data. In the design realm, deep learning models are extensively applied in tasks like image synthesis, style transfer, and intelligent creative generation. Unlike previous surges, AI is now out of the laboratory, merging closely with industries such as manufacturing and commerce. With the continual improvement of computational power, AI technology is rapidly iterating. Perceptual intelligence is maturing and finds application across various domains.

2.2. OpenAI's DALL-E Model and its Application in Design

A notable instance in the evolution of AI-assisted design is OpenAI's DALL-E model. DALL-E, combining natural language processing and image generation technologies, can produce image designs based on textual descriptions. This model finds extensive applications in the design sector, equipping designers with the capability to swiftly produce diverse design schemes. For instance, designers can input keywords or descriptions, such as "a castle in the blue ocean," and the DALL-E model will generate a design image that matches the description. This capability significantly expands designers' creative realm and potential.

However, while DALL-E can generate images based on prompts, it can't entirely replace a designer's creativity and expertise. The model's success rate also depends on the input text's intricacy, often leading to ambiguities in objectives and color relationships. Designers' aesthetic and creativity are still essential to optimize and refine DALL-E's generated designs to align better with human needs and emotions.

3. Current Status of AI-Assisted Design Courses

With the advent of the era of intelligent interconnectivity, smart tools, as the “informational productive forces,” are increasingly integrating with other disciplines. A close interdisciplinary connection has emerged between artificial intelligence and the field of design[3]. In 2017, the State Council released the “New Generation Artificial Intelligence Development Plan” to lead future technologies. The vision of this plan was to make higher education institutions, research institutions, and high-tech companies work together to build a brilliant chapter in the field of artificial intelligence[4].

3.1. Analysis of AI Design Courses at Foreign Universities such as MIT, RISD, and SVA

The Massachusetts Institute of Technology (MIT) offers a course titled “AI and Design,” aimed at revealing the magical integration of AI in the field of design innovation. The curriculum covers foundational knowledge in areas such as machine learning, computer vision, and natural language processing, combined with practical case studies and project development. The Rhode Island School of Design (RISD) offers a course called “Deep Learning for Design,” which teaches students how to use deep learning technologies to address design problems. The School of Visual Arts (SVA) in New York, a school focused on art and design education, explores innovative applications of AI technology in design. Course content includes deep neural networks, image processing, generative design, etc. Through practical projects and collaborative teams, students apply AI technology to the design process.

3.2. Analysis of AI Design Courses at Domestic Universities such as Tsinghua University and Tongji University

At Tsinghua University, the “Tsinghua AI Class,” founded by Academician Yao Qizhi, shines brightly. “Introduction to Artificial Intelligence” is the first mandatory subject in English for this class, set up in the students’ first academic year. The primary goal of this mandatory course is to introduce students to the technological focal points and cutting-edge results in the AI field, covering areas like intelligent perception, mechanized wonders, reinforced connections, AI integration, and innovative AI algorithms. The School of Architecture and Urban Planning at Tongji University, in collaboration with MIT and ETH, launched the “Digital Design and Intelligent Construction” workshop. They collectively design and construct large-scale man-machine collaborative arch structures using interdisciplinary knowledge such as programming, structural design, digital construction, and robotic assembly. The design framework is based on 3D modeling, the Python programming language, and open-source tools like the COMPAS framework. Through the course, students learn how to use AI technology to improve architectural design, urban planning, and the digital construction process.

3.3. Features of the “Art and Science Fusion + Digital Concentration” Digital Design Course at Wuhan University of Bioengineering

The Wuhan University of Bioengineering’s digital design course focuses on the “Art and Science Fusion + Digital Concentration” feature. The course encourages students to engage in interdisciplinary collaborations and practical projects. Students from bioengineering and visual communication design specialties participate in design projects to solve real-world problems together. With a core philosophy of integrating

art and science, the course aims to cultivate students' creative thinking and digital design skills (Figure 1).

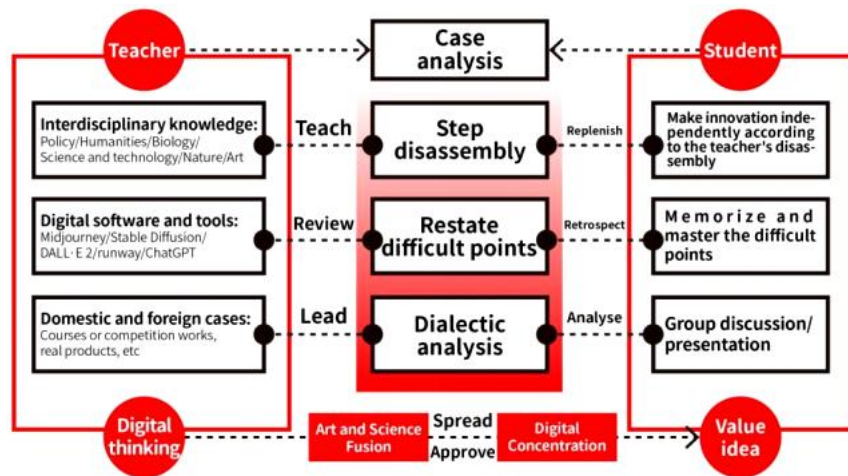


Figure 1. Features of the “Art and Science Fusion + Digital Concentration” digital design course.

In terms of digital technology, students learn to use digital design software and tools, including image processing, 3D modeling, virtual reality, etc. Throughout their practical journey, they will apply these skills to target design challenges in bioengineering, such as designing the appearance and structure of a bioreactor or optimizing the visual interface of laboratory workflows.

4. Artificial Intelligence-Assisted Design Course in the Metaverse Perspective

4.1. The Relationship Between AI-Assisted Design Courses and the Metaverse

In the realm of education, the AI-assisted design course has formed a mysterious and wonderful alliance with the metaverse. They complement each other, dancing together in the fantasy of the future, showcasing endless possibilities. The metaverse world possesses a “super brain”, yet its main entity remains human, requiring the human brain to work in tandem with AI to offer exceptional intelligence. By integrating AI-assisted design technology, realistic virtual scenarios can be created in the metaverse, offering a more immersive and interactive design experience, further refining the AI-assisted design course system (Figure 2).

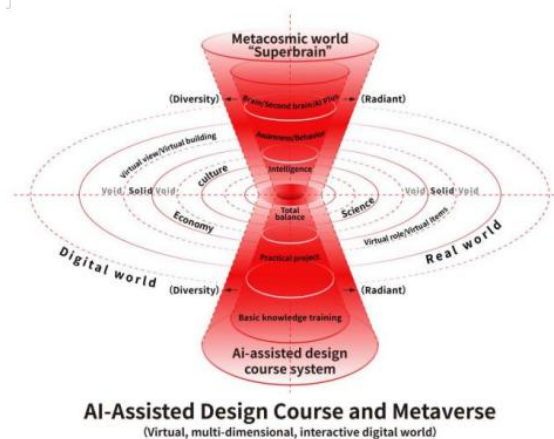


Figure 2. Relationship between AI-Assisted Design Course and Metaverse.

Taking the digital design course of Wuhan University of Bioengineering as an example, students can use the metaverse to construct a virtual laboratory and engage in various design practices. Students can use virtual reality technology to enter the virtual bioengineering laboratory in the metaverse and employ AI-assisted software for 3D modeling and simulation experiments. They can design and optimize bioreactors or gene sequences in a virtual environment and then use AI algorithms for simulation and optimization to achieve more efficient and sustainable bioengineering design.

4.2. Exploring the Teaching Model of the AI-Assisted Design Course

4.2.1. Introduce the latest AI-assisted design tools and software

In this rapidly changing era, artificial intelligence technology is emerging as refreshing as a spring breeze, with new algorithms and tools continually arising. Currently, the majority of AI falls under weak AI, also known as application-specific AI, which can only “make machines act intelligently” in addressing problems within their designated domains[5]. AI applications represented by facial recognition, voice recognition, image recognition, and AI anchors have paved the way for smart teaching service design for design courses[6]. The AI-assisted design course should introduce these latest tools and software, enabling students to master and apply these tools creatively. For instance, deep learning-based image generation tools can be introduced, allowing students to produce unique virtual artworks in the metaverse. When engaging in virtual reality design in the metaverse, students can learn and utilize AI-assisted design software related to virtual reality, like deep learning-based virtual scene generation tools.

4.2.2. Adopt the STEM teaching method and foster interdisciplinary collaboration

Artificial intelligence-assisted design delves into various academic fields, including data science, artistic design, psychology, and more. Given the multitude of research paradigms in artificial intelligence and the complexity of its content, it is particularly crucial to systematically organize its knowledge framework[7]. The STEM teaching method is an interdisciplinary educational approach, where S stands for Science, T for Technology, E for Engineering, and M for Mathematics. This method emphasizes real-world problem solving and teamwork, fostering students’ innovative abilities and interdisciplinary spirit. For example, when students need to design an intelligent waste classification system in the course, they can employ the STEM method for interdisciplinary design exploration. By integrating scientific knowledge (principles of waste classification), technological knowledge (sensor applications), engineering knowledge (system design and construction), and mathematical knowledge (data analysis and model optimization), educators can nurture students’ problem-solving skills, innovative thinking, and interdisciplinary collaboration. Similarly, design majors can collaborate with computer science, data science, and other majors to jointly develop and optimize AI algorithms, addressing complex design challenges together.

4.2.3. Emphasize ethics and legal education, nurturing designers’ sense of responsibility

AI is a cross-border technology, requiring international collaboration and consensus on standards. Due to the rapid development of AI and its diverse applications, there

has been a certain lack and disparity in global standards and norms for AI governance. With the consent of relevant departments such as the Ministry of Education, the Ministry of Science and Technology, and the National Development and Reform Commission, the “Interim Measures for Generative AI Services Management” came into effect on August 15, 2023. This enhanced the construction of laws and regulations, ethical norms, and data security. Therefore, in cultivating talents in the AI field, focus should not only be on academic proficiency and technical capabilities but also on integrating relevant laws, ethics, professional ethics, and social issues for thorough research [8].

5. Course Case Analysis of AI-assisted Design

5.1. AI-assisted Design Cases in the Fields of Virtual Reality and Digital Humans

Virtual Reality (VR) and Digital Humans represent significant application directions in AI-assisted design. By incorporating AI technology, design in VR and Digital Humans can achieve heightened efficiency, realism, and interactivity.

Facebook Spaces is a VR-based social platform that, using VR headsets, allows users to interact with friends in digital avatars. On this platform, users can craft their digital human likeness and engage in immersive communication and exchange via VR technology. AI plays a pivotal role in Facebook Spaces, utilizing technologies such as facial recognition, voice recognition, and semantic understanding, enabling the digital human to mimic users' expressions, movements, and language, and interact naturally with other digital beings, enhancing the social experience within a VR environment.

Digital Domain, a movie visual effects company, developed a project called “Meet Mike”, aiming to craft a hyper-realistic digital human character for interaction with users through VR. In this endeavor, they utilized AI and deep learning algorithms to gather and analyze data from real individuals, thus precisely replicating human appearance, movements, and speech. The digital representation of “Meet Mike” can converse and interact naturally with users in a VR setting, allowing communication, entertainment, or learning activities.

5.2. The Development in Human-Computer Interaction (HCI) and HCI Course Cases

Human-Computer Interaction (HCI) is one of the critical areas in AI-assisted design courses. By studying the principles and applications of HCI, designers can enhance the interaction between users and computers and improve the user interaction experience for mobile applications (APP UX). Smart assistant devices like Amazon's Alexa, Google's Assistant, and Apple's Siri communicate with users via voice interaction. Users can voice commands to ask questions, play songs, check traffic, etc., to which the device responds audibly or performs the respective tasks.

In many HCI courses offered by universities and research institutions, AI is emphasized to cultivate user-centered design capabilities. Within the HCI domain, the Human-Computer Interaction Institute at Carnegie Mellon University (CMU) is among the most notable entities. Their “Introduction to Human-Computer Interaction” course delves into the core concepts, methodologies, and processes of HCI, coupled with practical projects. Another course, “User Interface Software”, focuses on honing students' user research and interaction design skills, teaching the tools, technologies, and design patterns for user interface development. The School of Information

Science and Technology at Peking University offers an undergraduate course titled “Human-Computer Interaction”. This course encompasses both the theoretical and practical facets of HCI, including interface design, user experience evaluation, interactive technologies, visualization, and more, augmented by real-world projects to guide students on tool utilization.

5.3. Application Cases of Midjourney and Stable Diffusion in Art and Design

In 2022, AI painting tools like MidJourney, Stable Diffusion, and DALL-E2, in conjunction with the generative conversation model ChatGPT, successfully set off a surge in AIGC. The involvement of tens of millions of users led to rapid iterations of the AI models [9]. The popularity of generative AI stems from its ability to provide data closely resembling the real world through data synthesis in a cost-effective, scalable, and privacy-compliant manner [10]. MidJourney and Stable Diffusion are AI-based image processing and synthesis tools. They can swiftly generate design drawings with multiple comparative schemes, assisting designers in promptly completing their projects under tight deadlines. Additionally, they can offer designers inspiration and creativity by generating design concepts to aid the design process.

Designers can employ tools like MidJourney and Stable Diffusion to create digital paintings in various styles. With the assistance of AI algorithms, they can produce artwork that is both highly realistic and profoundly creative. In AI-assisted design courses, educators can instruct students on how to utilize these tools, enhancing their painting skills and creative capabilities. Through the study of AI-assisted design courses, designers can familiarize themselves with and apply these tools, broadening their creative horizons.

6. Conclusions

Research shows that AI-assisted design courses have indeed become a hot and cutting-edge subject in the field of design education. Higher education institutions should adeptly leverage the ever-emerging AI tools to ignite the flames of design innovation and nurture creative elites who excel in interdisciplinary collaboration and possess a heightened sense of responsibility. Through inheritance, courses can maintain their unique characteristics and academic traditions, providing students with a stable educational foundation. Through evolution, courses can remain vibrant, closely following the pulse of industry development, offering students fresher, more competitive education. Nonetheless, to continually enhance the course core and adapt to the challenges of technological changes, teacher training and resource support are imperative, and there's a need for long-term vigilance in educational assessment and improvement. Only in this manner can students be guided to unleash their creative ideas in the AI era and shine competitively.

Conflicts of Interest

The author declare that there is no conflict of interest regarding the publication of this article.

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