Graphic Design Education in the Era of Text-to-Image Generation: Transitioning to Contents Creator

Younjung Hwang and Yi Wu

Abstract

The advancement of generative artificial intelligence (AI) presents innovative opportunities and new challenges across various industries and academic fields. Particularly, recent advancements in generative AI, which can create images from text, are introducing new challenges in the field of graphic design education. This study discusses methods of graphic design education utilising generative AI, based on workshops conducted in the "Visual Culture and Contemporary Art" course in the first semester of 2023. Students utilised generative AI, such as Midjourney and DALL-E, based on the "Technology Pedagogical Content Knowledge (TPCACK)" model, to create posters depicting European design history. Through the analysis of case studies and survey results, researchers confirmed that graphic design education in the era of generative AI requires different educational goals and methods from those of traditional education. Students require AI visual literacy skills to accurately convey images using suitable keywords. Additionally, it was discovered that preliminary design processes such as trend analysis and research have become more crucial. Additionally, educators should provide students with opportunities to derive creative keywords through graphic storytelling and present a vision as content creators who combine science, art, and technology. This research provides guidelines for the roles of graphic designers and the direction of visual design education in the era of generative AI.

Keywords

artificial intelligence, generative AI, graphic design education, text to image, visual communication education

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Introduction

Generative Artificial Intelligence (AI) is a branch of AI technology that learns patterns from a database and utilises this knowledge to produce results based on user requirements. This technology is primarily known for its ability to generate various forms of data, including text, images, audios and videos. However, recent advancements in Generative AI have gone beyond generating similar data and now possess the capability to create entirely new creative works (Abukmeil *et al*. 2022; Gui *et al*. 2021).

In particular, image-generating AI, such as text-to-image systems, is expected to play a significant role in the field of graphic design. For instance, programs like Midjourney, DALL·E, and Stability AI have garnered attention for their ability to autonomously create images based on design keywords. Moreover, in March 2023, Adobe introduced Adobe Firefly, which can generate 3D images from text in addition to 2D images, expanding the scope of visual designers to three-dimensional realms. This shift in the paradigm of the design field is driven by the fact that generative AI can understand user intentions through commands and learn from provided data to create new content (Çelik 2023).

In addition, according to the literature review by Matthews *et al*. (2023), it is evident that AI is driving significant changes in visual communication and graphic design. Despite these developments, however, research on this topic remains relatively scarce, and some individuals perceive the automation process as a threat to the vitality of graphic design. This underscores the fact that visual communication design educators may not be adequately prepared for the impact of automation, AI, and ML. Researchers suggest the necessity to explore the role of future human designers effectively, in order to harness smarter and more efficient algorithms.

It is essential then for educators and design researchers to explore educational methods utilising generative AI, and the new role of graphic designers in the AI era. To this end, the research poses the following questions:

Q1. How can the objectives of graphic design education be defined in the era of generative AI?

Q2. What are the differences between such education and traditional graphic design educational objectives?

Q3. What could be the educational methods for effectively utilising generative AI in graphic design, and what are the challenges for students?

Q4. What is the role of future graphic designers, and what educational elements should educators provide?

Background

The instructional methodology is based on the educational potential of AI; text-to-image generative AI; and the integration of AI into graphic design.

Generative AI in education

Recent research in the field of education has engaged in in-depth discussions on the possibilities and limitations of generative AI. Zhai *et al*. (2021) conducted a comprehensive analysis of research papers exploring how AI had been applied in education from 2010 to 2020. They categorised these papers into development layers (classification, matching, recommendation, and deep learning); application

layers (feedback, inference, and adaptive learning); and integration layers (affective computing, role-playing, immersive learning, and gamification). They also addressed the inappropriate use of AI technology and challenges that may arise in education, enhancing the theoretical basis of AI education.

With the advent of text-generating AI such as ChatGPT, research incorporating these technologies has been undertaken. According to Baidoo-Anu & Owusu Ansah (2023), ChatGPT, a conversational generative AI, can positively impact formative assessment activities by promoting interactive learning and providing continuous feedback to students. However, the authors also acknowledge educational limitations, such as the generation of incorrect information, as well as provide recommendations for educators to maximise the use of AI in education.

Su & Yang (2023) proposed a theoretical framework for educational AI, known as "IDEE," which includes identifying desired outcomes; determining the appropriate level of automation; ensuring ethical considerations; and evaluating effectiveness. In the educational field, there is ongoing exploration of the role of generative AI, like ChatGPT, as it is integrated into the actual educational landscape, considering its potentials and limitations. Furthermore, AI's capabilities have evolved into higher dimensions, with educational models being continuously explored across various disciplines. In the field of science education, Cooper (2023) anticipates AI's usefulness for educators in designing science units, assessment criteria, and quizzes. In engineering education, it is predicted that AI will provide tailored feedback, explanations, and create realistic virtual simulations for practical learning.

Generative AI in art and design education

In parallel with the advancement of image-generating AI, recent research and discourse in the field of art and design education have unfolded, exploring the utilisation of AI. Vartiainen & Tedre (2023) focused on the capabilities of generative AI's text-to-image functions and conducted creative work workshops using generative AI in Finnish arts and crafts classes. They discovered the creative potential of image-generating AI from an ideation and creative expression perspective. However, they pointed out the potential for copyright violations and the constraints of limited algorithmic structures, while describing the boundaries between creative work and generative AI.

In the field of design, discussions are emerging regarding how AI programs that convert text into images, such as Midjourney and DALL-E, can foster students' creativity to produce innovative and sustainable designs (Fathoni 2023). Specific curriculum development is also underway. McCardle (2002) applied AI technology to the undergraduate industrial design curriculum in the United Kingdom, suggesting that innovative design solutions could be derived with appropriate technological support.

In the field of visual design, Matthews *et al.* (2023), conducted a literature review regarding the impact of automation, AI, and ML on visual communication, particularly focusing on the subdomain of graphic design. The researchers evaluated the influence and outcomes for practitioners in graphic design education. They found that published research on this topic was relatively scarce, and noted a lack of preparedness for automation, AI, and ML within the field of visual communication education. They concluded that practitioners should view machines not as competitors that take over design tasks or disrupt industries, but as potential collaborators, intermediaries, and integral parts of the digital ecosystem.

Generative AI tools in graphic design education

Generative AI tools are currently under extensive research within the field of graphic design, offering a multitude of applications in conveying information or messages through visual elements. For instance, creative AI applications such as Chat-GPT, DALL-E, and Midjourney are used as visual brainstorming tools to swiftly visualise ideas or represent multiple versions of a single concept (Chen *et al*. 2024). Additionally, they serve as expressive tools in collaboration with actual artists to create graphic design works (Patil 2023).

However, according to Matthews *et al*. (2023), there is still a scarcity of research in the graphic design field concerning generative AI. In particular, the precise assessment of creativity when collaborating with AI has not been firmly established. Therefore, they emphasise the need for graphic design education approaches that align with the new design paradigm driven by generative AI, and to mitigate aesthetic, social and ethical issues that may arise due to generative AI.

Furthermore, researchers are taking note of the recent development of AI programs that can perform visual tasks faster and more cost-effectively than human designers. This has led to the assertion that design educators and researchers should reform graphic design education in response to changes in the industry.

Methodology

Building upon the research and practical cases of AI in graphic design, the researcher conducted a four-week workshop on poster design utilising generative AI for 29 graduate students. It was held during the course on "Visual Culture and Contemporary Art" from March 15, 2023, to April 7, 2023. The workshop aimed to explore the fundamental principles and structure of AI design; acquire proficiency in the use of AI tools; and explore the role of human designers in the AI design era. The participants were graduate students, aged 22–23, with diverse undergraduate majors in fields such as visual design, spatial design, product design, and civil engineering. Due to the significant variation in their majors, it was determined that using text-based generative AI to create poster images would be an efficient approach. They also provided feedback (approximately 300 characters in length) through a survey, to evaluate the AI platform.

This study employed the Technological Pedagogical Content and Competency Knowledge (TPCACK) model in conjunction with the Goal-Based Scenario teaching method. The TPCACK model combines pedagogical knowledge, content knowledge, and technological knowledge to effectively convey the educator's expertise and technological skills to students through content (Mishra & Koehler 2006; Lin *et al*. 2013; Voogt *et al*. 2016). This approach combines technological knowledge with Shulman's (1985) pedagogical content knowledge concept, which conceptualises a teacher's expertise in a specific subject area. Koehler & Mishra (2009) have specifically elaborated on the TPCACK model, making it widely used in practical applications (Figure 1).

Through technological knowledge, learners were first trained to grasp the fundamental structure of text-based generative AI. Originally, generative AI evolved from the structure of a min-max game between the generator and discriminator in Generative Adversarial Networks (GANs). The generator tries to create realistic

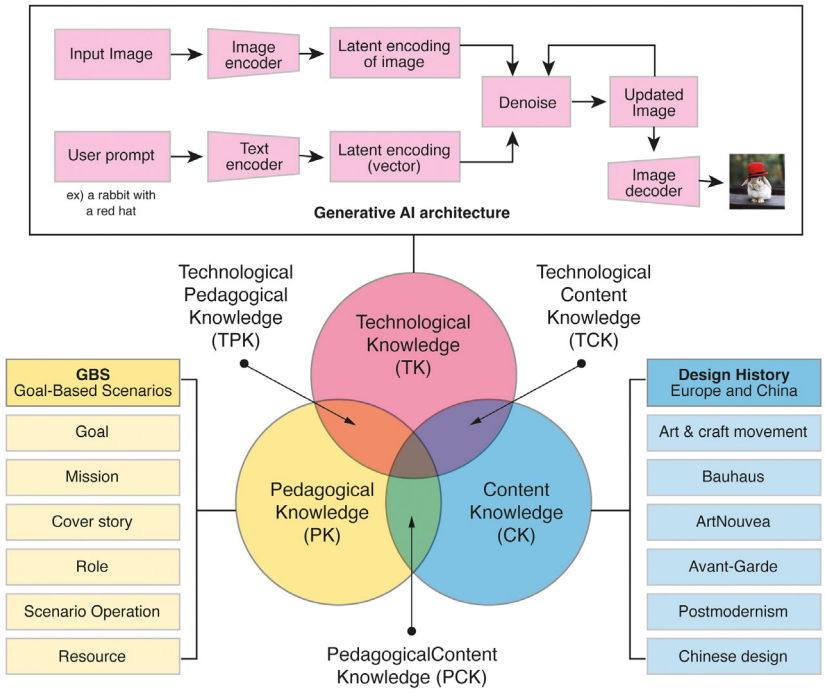

Figure 1
A Pedagogical Model for Generative AI Design Based on the TPCACK Framework.

samples that can fool the discriminator, while the discriminator attempts to correctly distinguish between real and generated samples. On this basis, diffusion models are deemed to provide a more stable training objective than GANs and demonstrate superior generation quality compared to VAE, EBM, and normalisation flows (Dhariwal & Nichol 2021). Through this exposure, students learned the generation structure of the specific generative AI program they were using and acquired foundational technical knowledge about generative AI.

Secondly, pedagogical content knowledge focused on studying the history of 20th-century European design and Chinese design history, with an emphasis on creating graphic posters using generative AI. Since generative AI produces more accurate and diverse results when trained on a large amount of user data (Rashid 2021), the researcher primarily taught European design history, which has rich image data and a well-established theoretical background. Students input relevant texts and images into the generative AI to generate poster images representing different design trends.

Lastly, in terms of pedagogical knowledge, the researcher applied the Goal-Based Scenarios (GBS) instructional methodology to motivate the students and plan learning objectives and assignments. GBS, a learning model proposed by Schank *et al.* (1994), emphasises "learning by doing" through a simulation-based approach where learners perform tasks based on real-world contexts. In GBS, students engage in tasks they might encounter in the real world, gaining meaningful learning experiences (Iverson & Colky 2004). Thus, the researcher adopted this instructional method as it aligns with having students utilise generative AI

TABLE 1 Details of the study phases based on the TPCACK model

Study phase	Visual culture and contemporary art		
Week	**2023.3.15-4.7 (8classes)**	**Number of students**	**29**
Education Goal	Design history and culture with AI		
Education Tool	Image Generative AI (Midjourney, DALL·E, Stable Diffusion)		
Submissions	Poster design, logo design, PPT (AI prompt and draft, design process)		
TPCACK Frame	Content knowledge(CK)	Technological knowledge(TK)	Pedagogical knowledge(PK)
Week 1	Arts&Crafts Movement	Generative AI	Set Goal of class
Week 2	Bauhaus	Image Generative AI	Mission development
Week 3	Art Nouveau	Input Image	Create a cover story
Week 4	Russian Avantgarde	Input User Prompt	Role AI and Designer
Week 5	Post modernism	Modify Image and Prompt	Practice Design Scenario 1
Week 6	International style	Output Image	Practice Design Scenario 2
Week 7	Chinese design	Update Image	Practice Design Scenario 3
Week 8	Exhibition	Image Feedback	Check resources

technology to create graphic posters (Goal). Each student was given a mission to explore the design trends and philosophies of different design eras (Mission), adopt the role of a designer or artist from that era, and express the ideologies and trends through poster design (Cover story & Role). The poster designs, produced through this role-playing approach (Scenario operation), were created using generative AI programs such as Midjourney, DALL-E, Stable Diffusion. Additionally, the school's collaborative platform, Pinwall, was utilised as a physical resource for these assignments (Table 1).

The learners' outcomes and discoveries are presented in the following stages. Learners made use of various generative AI programs, with a primary focus on Midjourney, DALL-E, Stable Diffusion, and Nolibox. Through mutual feedback, students refined their prompts at each stage, allowing them to obtain their desired results more quickly and effectively. The researcher required students to submit two types of presentations after each class: a design research summary pertaining to the respective design trends, the poster's intent, prompt keyword text, and idea sketches. Furthermore, by capturing the production process through keyword dialogues with AI, they ensured that students could observe how the images were modified, enhanced, and completed. Evaluation criteria primarily emphasised the aesthetic value of the work; concept expression; comprehension of content; appropriateness of the design process; and the potential for AI utilisation. Instructors provided feedback on each poster, suggesting improvements in terms of formal aspects of poster production and modifications to prompt keywords, as well as outlining future development prospects (Figure 2).

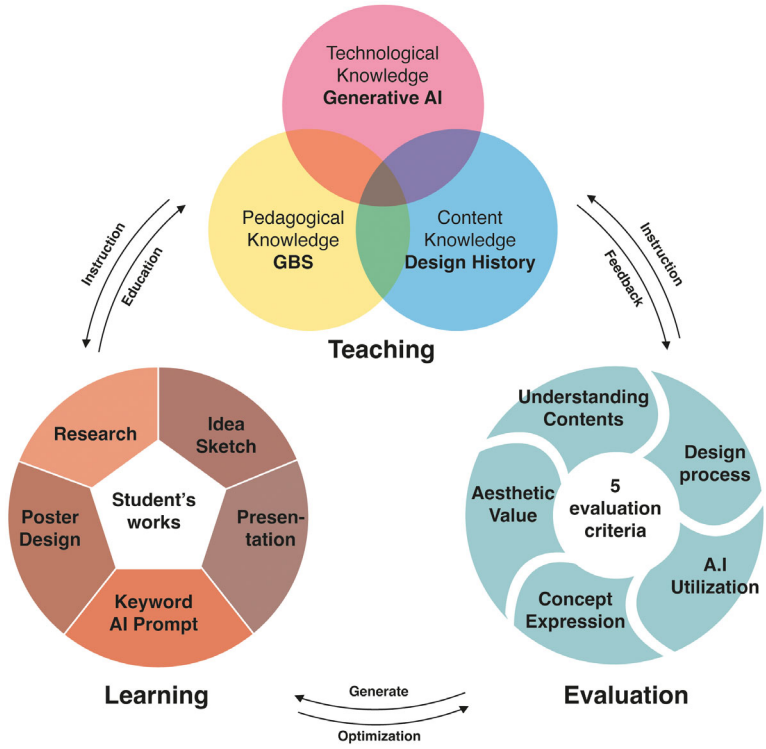

Figure 2
Teaching-Learning-Evaluation Framework.

Findings and discussion

In the next subsection, we will focus on the data collected during the eight workshops held from March 15 to April 7, 2023. These workshops encompassed a total of 8 thematic topics, resulting in 232 research investigation presentations, 276 poster design datasets, and 29 survey feedback responses. Utilising this data, the researcher comprehensively discusses the direction and objectives of graphic design education in the AI era, along with the evolving role of future graphic designers. The entire exhibition can be viewed at the following Pinwall link: https://pinwall.cn/workFolder/1245 [03July2023].

Q1: AI visual literacy education: fostering keyword communication skills

Generative AI can create digital artworks even without a deep understanding of design techniques, simply by generating text prompts in natural language (Oppenlaender 2022). As this technology progresses, there's a growing necessity to reassess education regarding 'visual literacy,' which involves accurately interpreting and creating visual content (Brumberger 2019). In the age of generative AI, students need to be engaged in AI visual literacy education to effectively interpret and modify AI-generated images. This education also entails the skill of communicating with AI through precise prompts and keywords while producing graphic images.

TABLE 2 The students' challenge of communicating with AI through keywords

Student participant	Comment
Participant 4	I believe the most challenging aspect is finding the appropriate keywords to describe my thoughts. To address this issue, I recently attempted to create my own AI vocabulary. By designing keywords that correspond to my design style through the keywords of others, I was able to enhance the efficiency of finding keywords
Participant 6	In reality, the difficulty lies in how to transform the thoughts in my mind into prompts for text. While there is an ideal style in my head, I struggle to express it in professional terms (nouns). Therefore, I see expressing thoughts and keywords from my mind as a new challenge for designers
Participant 15	I've learned that if the input prompt is not accurate or appropriate enough, the generated image can be completely different from what I had in mind. Sometimes, when I try to input common topics like 'stars in the night sky,' the generated image turns out to be completely different from what I expected

Based on this characteristic, the researcher placed a strong emphasis on text generation through preliminary research, aiming to differentiate this from traditional design classes. Participants were encouraged to conduct thorough preliminary research concerning the historical, societal context, cultural background, and artistic trends relevant to their poster-making process. Subsequently, they summarised this information in text format and extracted keywords.

The experimental results confirmed that a comprehensive understanding of text, content, and context, influences the outcome of the generated images. This is due to the limitation of image-generating AI, which requires the ability to express the desired output linguistically (words and prompts). Additionally, as training data for generative AI is still insufficient and algorithms have limitations, using universal keywords can lead to biased results (Fui-Hoon Nah *et al*. 2023). To overcome these linguistic limitations and biases, users need to train AI with a variety of topics and provide more specific and clear prompts. In fact, during the workshops, it was observed that using personalised prompts based on pre-learned content produced distinct graphic design results compared to when generic prompts were used. These posters not only mentioned the designers representing the respective trend but also provided specific details in writing, such as reference images, compositions, poses, colours, and other concrete elements (Table 2).

Students described the challenges of dealing with keywords in generative AI and the designer's dilemmas as follows:

In other words, to generate the desired output through prompt input in generative AI, learners need to summarise and extract keywords efficiently through prior theoretical learning and exert efforts to describe them in refined language. This signifies the extension of the audience in the field of visual communication from human peers and employers to machine AI. It also highlights the significance of literacy-based, concise, and efficient communication in design.

Q2: Extending digital curation: from output to process education

The traditional objectives of visual design education were centred around students independently producing graphic outputs such as posters, brochures, and banners

(Heller 2015). However, in graphic design classes utilising generative AI, the importance of the design process is further emphasised due to the characteristic of 'image curation.' In these classes, creators first select a collection of images to supply (Pre-curation) and provide these inputs to generative AI algorithms seeking to mimic them. Then, in the final stage, they curate and select the final image from numerous output images within seconds (Post-curation). The role of the creator involves curating suitable images and crafting effective prompts (Mazzone & Elgammal 2019), making the precise design process and research activities for generating results far more crucial educational objectives than before. Through these design process steps, learners can identify fundamental issues in design thinking and think vertically and horizontally about problems associated with various inputs of concepts, ideas, and practical knowledge (Öztürk & Türkkan 2006). Consequently, educators should assess not only the final output but also various stages of the creative process, such as initial concepts, outlines, and prototypes, and may require process reports containing rejected ideas, research notes, and feedback (Fathoni 2023).

Based on this information, the researcher guided students to use generative AI for poster creation sequentially, starting from the initial research and idea sketching stages. Students collected relevant materials and reference images using text generation AI and search AI. They completed their idea sketches through brainstorming sessions. Next, they inserted the prompt text they had learned into the generative AI to extract design drafts. Through this experiment, students experienced how investing time in the design process allows them to select and obtain more purposeful outcomes, leading to a deeper exploration of how the collaboration between artificial intelligence and human design can unfold (Table 3).

In a class, one student described how research and the design process can play a crucial role in the use of AI.

Thus, while generative AI enables the rapid creation of images from text, it necessitates a deep design process to generate precise prompts. To facilitate effective AI education, design educators need to emphasise research, curation, idea sketching, and other aspects of design research in the student's creative process.

TABLE 3 The importance of the research process to derive appropriate keywords

Student participant	Comment
Participant 2	The text I inputted into the generative AI is all represented in visual images, which sometimes led to ambiguity. Therefore, creating a poster with AI is not simply about inputting commands to obtain images; it requires an understanding of the stylistic characteristics I desire for the poster during the process. I believe deriving such clear prompts requires personal research
Participant 8	AI analyzes designs that appeal to the masses through extensive data research. Through this, I can understand the design demands and behaviors of the public and it has helped create appropriate keywords

TABLE 4 Student's Reflections on Collaborative Storytelling with AI

Student participant	Comment
Participant 2	AI-driven creativity in the era of AI is a rebellion against any authoritarianism in art. To express this critical design concept, I depicted robots piloting spaceships and sparking a revolution against humanity on posters. Such unique storytelling helped me create keywords different from others
Participant 8	At times, the 'mistakes' of AI can trigger a designer's creativity and inspiration. For instance, while working with AI on Russian avant-garde posters, it mistakenly generated the Statue of Liberty due to a misinterpretation. However, I found this more intriguing and emphasised the significance of the revolution inherent in Russian avant-garde by placing this Statue of Liberty at the center of the screen

Q3: Graphic storytelling: extracting unique keywords

Image-generative AI, with its limited keywords and image-referencing structure, can also give rise to copyright infringement and plagiarism issues related to specific artists' works(Fui-Hoon Nah *et al*. 2023). Therefore, educators need to find ways to promote students' critical thinking and nurture human creativity as they harness AI technology. Encouraging students to generate original ideas and reduce the possibility of plagiarism (Fathoni 2023), as well as incorporating graphic storytelling with unique narratives can be an effective method for enhancing students' creativity. Particularly, creativity is required to address characters and settings in storytelling, which can be developed as a major educational tool in the field of visual arts (Rifà-Valls 2011). Students tend to make efforts to derive creative keywords to imbue a scene with a unique narrative and story. Such endeavours can be regarded as a challenge for learners distinct from the repetitive creation of machines (Table 4). For instance, Figures 3–5 shows: (a) a student incorporated a narrative in the Art Nouveau poster: "Astronauts are flying between Earth and space;" (b) a student included a narrative for the Art Nouveau poster: "An angel descends from the sky to guard the Eiffel Tower;"; (c) a student assigned a narrative to the Russian Avant-Garde poster: "A robot battalion lines up in front of a massive battleship;" and (d) a student added a narrative to the Postmodern graphic poster: "Mechanical notebooks are working together with humans."

Students in the class derive unique keywords while creating stories for posters, then imbue new narratives inspired by images generated by AI. The students described the collaborative process with AI as follows.

In other words, digital storytelling education utilising generative AI allows students to cultivate originality distinct from machine-generated creations by exercising creativity in deriving unique keywords.

Q4: Content creator: the fusion of art, science, and tradition

In contemporary graphic design, visuals are considered a means to convey content and messages about how the world should be and what to pursue. Postmodernist graphic designers, especially in the 1980s, who championed deconstruction, engaged in activities that encompassed various areas as designers, artists, and curators. They emphasised their authorship and presented provocative and creative expressions. Modern graphic designers are increasingly blurring the boundaries

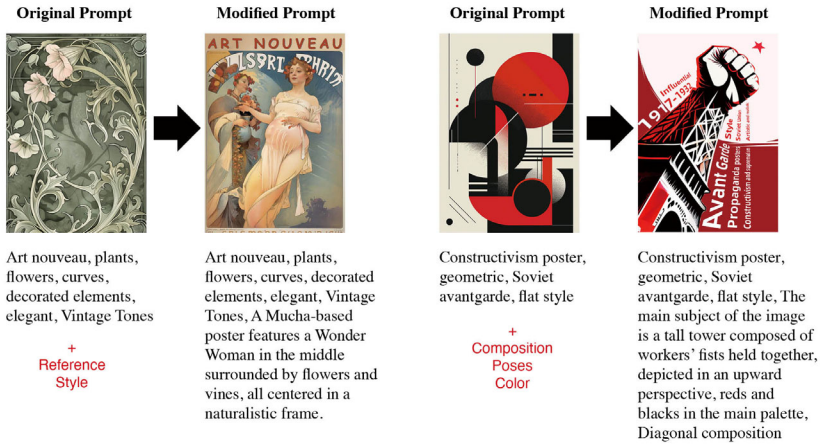

Figure 3
The Change in Image Generation According to the prompt Description.

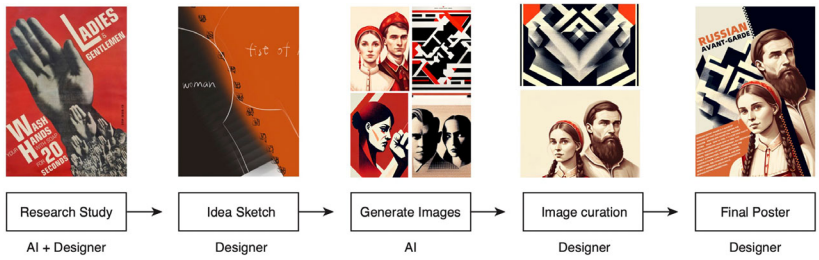

Figure 4
AI and Human Collaborative Poster Case Based on Design Process.

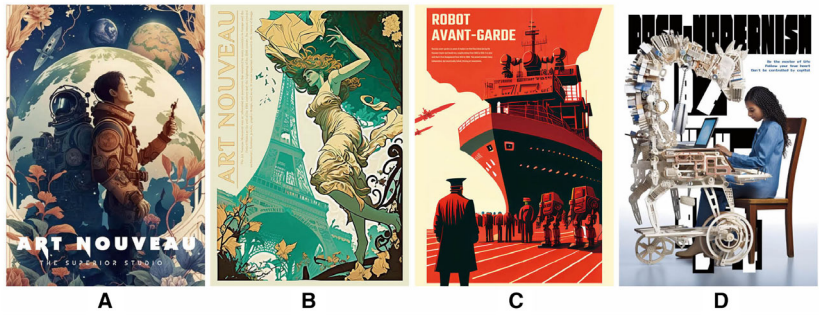

Figure 5
Examples of Unique Narrative Stories Assigned to Prompts.

between commercial, public, and societal aspects, actively serving as creators of self-expression. The lines between designers and artists are becoming more ambiguous (Poynor 2013). Particularly, with the introduction of generative AI and the lowered barriers to art production, the community of designers and artists has

expanded, resulting in diverse visual outcomes (Epstein *et al.* 2023). Therefore, future graphic designers should strive to become content creators who convey meaningful messages to the world using various mediums such as generative AI. Simultaneously, educators should cultivate learners' abilities to effectively utilise generative AI as an artistic tool. In fact, with the advanced development of AI, the boundaries between art and science have blurred, and algorithms have expanded into the domains of artists as well, not just computer scientists (Hutson & Lang 2023). Designers should actively blend not only art but also science and technology, necessitating the fusion of various domains to create content. In this context, traditional materials and themes from different cultures can serve as a rich source for content.

One student in the class, working on the theme 'The Future and the Past of Chinese Design,' created an AR moving poster with the title 'Opening the Door of Chinese Design.' In traditional Chinese concepts, 'opening the door' symbolises the arrival of good luck. In the poster, the 'door' symbolises the Chinese design transitioning into a hopeful future by depicting the door's opening and closing. The student used generative AI, specifically Midjourni, to input the prompts that could generate visual representations of this concept. The initial image drafts were created using Adobe Photoshop for further editing. Subsequently, Adobe After Effects was utilised to turn these images into a video. The final output was an AR poster using the Kivicube AR (augmented reality) program. When capturing the poster with a smartphone, a video is played, showing a person opening the designed door and moving into a new world (Table 5 and Figure 6).

Such cases imply that generative AI in education should be more than just a final tool for graphic image production, but rather a supplementary medium for efficiently conveying content visually. Students described their creative process with AI as follows:

In other words, the role of generative AI can be summarised as complementing human creators as work partners, increasing work efficiency, and enabling human creators to immerse themselves in pure creativity. Therefore, graphic design educators should not focus solely on the technology of generative AI. They should,

TABLE 5 Student's Insights on the Role of AI as a Creative Partner in Design Education

Student participant	Comment
Participant 12	I could contemplate and impart meaning to the direction of the posters together with AI, functioning as a 'partner' tool in the process
Participant 16	Although there is frequent reporting on AI replacing human tasks, through this practical activity, I realised that AI exists as just a tool. With just a simple explanation, we can create various draft images, greatly improving efficiency compared to traditional image production methods
Participant 21	AI has the potential to be a valuable tool for mass or commercial design production. While AI may not create perfect designs, it has sufficient capabilities to generate designs that meet market demand. Its greatest feature lies in effectively compressing some of the advantages of pioneering design works (layout, colour, etc.) and presenting them

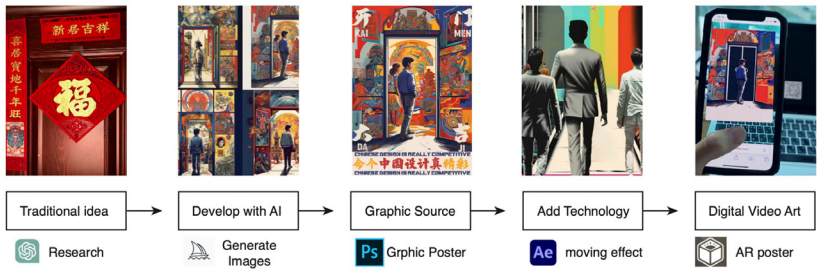

Figure 6
An Artwork that Combines Tradition and Technology to Express Content.

instead, structure their curriculum while taking into account how students can create content and convey it through various visual media using generative AI.

Conclusion

Overall, the workshops and survey results of students indicate a shift in the direction of graphic design education in the age of generative AI. In the past, when creating posters in design programs, the key focus was on the visual elements that make up the screen. However, in the era of generative AI, it has become apparent that learners need to acquire an AI visual vocabulary and enhance their ability to generate images based on specific and accurate prompts, grounded in literacy. Furthermore, to mitigate the potential issues of copyright and plagiarism that can arise from generative AI, learners should insert unique keywords into their graphics, based on critical thinking and storytelling. Furthermore, educators should enhance design research process education and teach students how to explore accurate keywords and curate appropriate images.

This study holds significance in exploring literature related to generative AI and graphic design education, and in investigating the objectives and methods of graphic design education in the era of generative AI through case analysis. Additionally, it can contribute to the development of practical guidelines for educational processes by specifically presenting examples of student utilisation through artwork analysis and surveys conducted during the case analysis process. The proposed educational methods, however, have limitations due to the absence of a quantitative research model, which deem them lacking in empirical evidence. This study which was based on classroom workshops, surveys, and artwork analysis, need additional research and experiments to derive a concrete curriculum and prove the results. In future research, researchers aim to validate the effectiveness and potential of this educational approach through data-driven surveys and satisfaction assessments, and propose a more specific educational framework based on generative AI.

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Younjung Hwang is an Assistant Professor at the Hunan University, Changsha, China. Her research interests include artificial intelligence and visual design, STEAM, and graphic design education. Her current research encompasses visual communication education that integrates technology such as generative AI, into graphic design, branding design. Email: yjhwang@hnu.edu.cn

Yi Wu is an Lecturer at the Hainan University, Hainan, China. She is a graphic designer, with a PhD in Design from Seoul National University University, South Korea. Her research interests include artificial intelligence and visual design, design education, and graphic design education. Email: wuyi@hainanu.edu.cn

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