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Potential applications of AI-generated doll imagery for unique agricultural products

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Abstract

Faced with the rapid advancement of AI-generated image technology (AIGIT) and its ability to lower learning barriers, traditional design-education still has numerous challenges, such as limited time, varying artistic abilities, and creative bottlenecks. The authors tried to explore the application of AIGIT (specifically using the Stable Diffusion (SD) platform) in doll design education and the promotion of Taiwanese agricultural products (guava). A three-hour AI image generation training (prompt design to optimization) was assessed for its impact on boosting student creativity and efficiency. The final doll designs further were evaluated by industry experts across five dimensions: visual appeal, character characteristics, emotional expression, consistency, and functionality. Questionnaire results, visualized via R-programmed radar charts, revealed AI-assisted design fostered culturally resonant, visually appealing mascots, with iterative prompt refinement boosting success rates. AI emerged as both a creative and pedagogical tool, enhancing innovation and cultural branding. Besides, practical implications include strengthening local agricultural products through character design, while educational implications highlight AI's role in lowering barriers to creative expression. The originality of this study lies in its integration of AI-generated doll imagery with agricultural product promotion, offering a novel model for design education and regional agricultural cultural development.

Keywords: *Artificial intelligence generated image technology; Doll design; Agricultural special products*

1. Introduction

With the rapid advancement of deep learning and large-scale computing resources, artificial intelligence-generated image technology has evolved from early generative adversarial networks (GANs) to diffusion models and text-to-image systems such as DALL-E and Stable Diffusion, which can automatically generate diverse, high-resolution visual content based on natural language prompts (Guo & Shin, 2025; Ho et al., 2020). These technologies have not only revolutionized designers' creative processes but have also had a profound impact on fields such as industrial design, visual communication, and entertainment, bringing unprecedented teaching and learning tools to design education. However, at the current stage, design education in the classroom still faces challenges such as time-consuming teacher demonstrations, uneven artistic skills among students, and/or creative bottlenecks (Jeng, 2019). Therefore, how to integrate emerging technologies into limited classroom time and resources to improve teaching efficiency and learning outcomes has become a challenge that educators urgently need to address. But whether artificial intelligence-generated image technology (AIGIT) can truly enhance students' creative thinking abilities and learning motivation still requires systematic evaluation to verify its effectiveness.

2. Research Objectives

The purpose of this study was to evaluate the design quality of dolls following the implementation of a 3-hour AI-generated Taiwanese agricultural product (guava) doll-design training program in the classroom using a free AI stable diffusion (SD) platform. Based on students' learning outcomes in AI-generated design, the findings will be used as a model by educators to enhance their future teaching methods.

3. Literature Review

3.1 The Relationship between Doll Design and the Promotion of Taiwanese Agricultural Products

Doll design, as a comprehensive design form encompassing visual communication, character creation, and cultural narrative, has seen its definition and functions evolve alongside shifts in era and medium. Traditionally, dolls were viewed as children's toys, emphasizing anthropomorphic design and emotional projection functions (Calvert, 1999). However, in the 21st century, doll design has gradually transformed into a core element of brand identity, cultural symbols, and cross-media narratives, encompassing multiple aspects such as character design, IP development, cultural and creative products, and local marketing (Jenkins, 2006).

From a perspective of design theory, dolls are not merely sculptural objects but also symbolic carriers. Barthes (1977) noted that the form, color, and structure of design objects

all carry specific cultural connotations and narrative functions (Barthes, 1977). Doll design achieves this through character design, emotional attachment, and narrative context, making them recognizable, memorable, and interactive cultural symbols. Yano (2013) used Hello Kitty as an example to illustrate how “soft character design” can establish a global character brand through simplified design and emotional appeal (Yano, 2013). In Taiwan, character design is gradually being incorporated into the promotion of agricultural products and the construction of local brands, becoming an important strategy for cultural marketing and industrial innovation. Local governments and agricultural associations are strengthening the cultural narrative and brand identity of agricultural products by designing characters with local characteristics. For example, Yao and Wu (2021) designed a doll for the Tientoushui community in Changhua County located in central Taiwan. This doll combined the imagery of local agricultural products with a friendly design, successfully attracting the attention of young people and tourists. Such design strategies not only enhance product recognition but also promote the reproduction of local culture and emotional connections (Yao & Wu, 2023). Through the storytelling packaging of doll characters, agricultural products are no longer just functional commodities but narrative carriers that embody local memories and cultural values.

3.2 Artificial Intelligence (AI)

Artificial intelligence (AI) refers to a machine's or computer's ability to simulate human thought processes, first introduced by McCarthy et al. (1956) and later developed through various schools of thought like bionics and cybernetics (Gong & Jiang, 2020; McCarthy et al., 2006). Today, AI is defined as a system's capacity to understand external data, learn from it, and adapt to achieve specific goals (Haenlein & Kaplan, 2019). Artificial Intelligence Generated Content (AIGC) focuses on processing visual data, such as images and videos, with several applications in graphic design: A) Automated Design: AI can create initial design sketches that can be modified by designers, improving efficiency and allowing non-professionals to produce quality work. B) Format Conversion: Using Neural Style Transfer (NST) technology, AI can convert designs into different styles, giving designers flexibility. C) Material Generation: AI employs techniques like Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs) to generate new design materials in various styles. D) Image Enhancement and Repair: AI can improve low-quality images and repair damaged ones, offering more usable resources for designers. E) Prediction and Optimization: AI can predict design reception and optimize it for better user outcomes, enabling designers to create more user-centered work (Chen, 2018; Gatys et al., 2015; Liang et al., 2018; Rocca, 2019; Yao et al., 2025; Zou et al., 2021).

3.3 The Needs and Challenges of Design Education

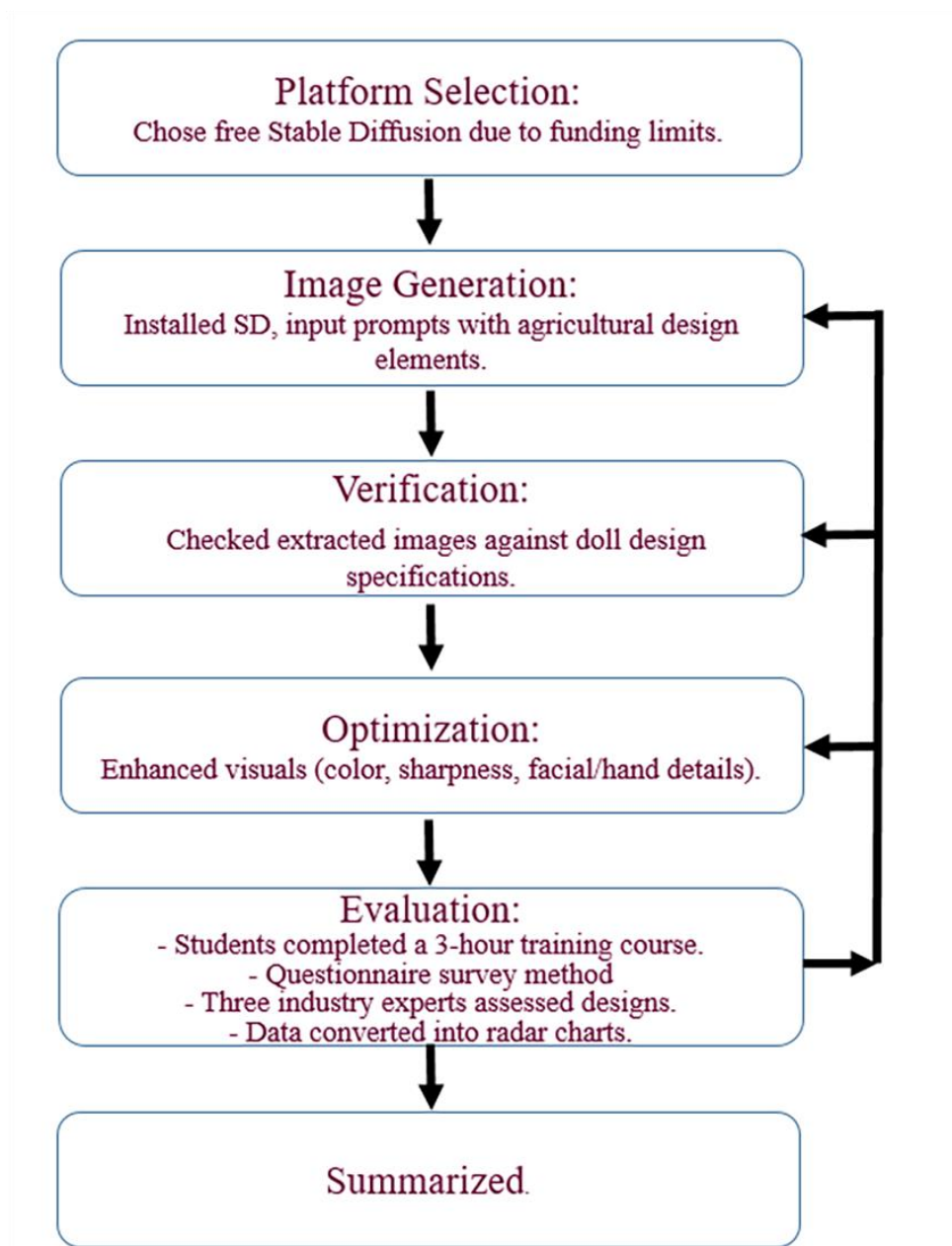
In traditional design classrooms, teachers often have to draw examples themselves or rely on students' hand-drawn sketches to guide them in understanding abstract

composition, color coordination, and visual storytelling concepts. However, this process is time-consuming and requires a high level of artistic foundation from both teachers and students, which can lead to insufficient classroom interaction or a loss of creative motivation. Currently, the application of artificial intelligence (AI) technology in education has gradually become a global trend, especially in design education, where AI has not only changed the creative process but also redefined teaching methods and learning models. Design education emphasizes creativity, visual expression, and critical thinking, and the introduction of AI technology has provided new possibilities for cultivating these core competencies.

However, it has also raised a series of challenges in terms of education, ethics, and technology. First, the application of AI in design education can be divided into three main areas: creative assistance, personalized learning, and teaching automation. AI-generated image tools such as DALL-E, Midjourney, and Stable Diffusion can help students quickly produce visual sketches during the conceptualization phase, lowering the barrier to entry for creation and enhancing creative fluency and visual expression. These tools not only accelerate the design process but also promote students' understanding and application of design language. Secondly, AI technology also promotes the development of personalized learning. Through learning analytics and adaptive recommendation systems, teachers can provide customized teaching materials and feedback based on students' learning behaviors and work styles (Yao et al., 2025). This data-driven teaching model helps enhance learning motivation and effectiveness, particularly in multicultural and interdisciplinary design courses, where it can effectively address students' diverse backgrounds and learning needs.

4. Research Methods

The study trained 12 students (all digital design students, 2 women and 10 men, aged 19 to 22) to design agricultural product mascots using the free Stable Diffusion AI platform. After attending a three-hour lecture on prompts for AI-generated images, they generated doll images via prompts, refined visuals, and optimized details. Final designs were evaluated through expert-reviewed questionnaires and then converted into radar charts by using R programming, focusing on visual appeal, characteristics, emotional expression, coherence, and functionality. The research frameshift was as follows:

Figure 1 Flowchart for Completing the Three-Hour AI-Generated Doll Design Course

4.1 Practical Operation and Procedures

Many artificial intelligence (AI) platforms are available on the Internet today that can help designers create works. Some of the more well-known platforms are Stable Diffusion, Leonardo (<https://leonardo.ai/>), Midjourney network (<https://www.midjourney.com/>), and dreamlike.art (<https://dreamlike.art/>). However, due to limited project funding in this study, the authors attempted to teach students to use the free AI-SD platform, directly inputting prompts to design and generate brand doll designs.

4.2 AI Operational Steps

The operational steps that AIGC technology presented were as follows. 1) Use AI to create images: The SD platform should be installed first. 2) To have the AI produce the

anticipated visuals of commercial dolls, provide prompts that incorporate design code elements taken from agricultural specialty products. 3) Re-evaluation and verification of design symbol elements: Once the required images and graphics have been extracted, assess the design to make sure it satisfies doll design specifications. 4) Image optimization and enhancement: To improve image quality, make use of platform capabilities or additional graphic design applications. By changing colors, sharpening photographs, and fine-tuning hand and facial details, the overall visual impact was presented in the most suitable manner.

4.3 Final AI-Generated Image Design Evaluation

4.3.1 Expert Assessment

To evaluate the quality of agricultural product mascots designed by students after completing a three-hour AI-generated image for training course (Table 1), the author referenced the questionnaire survey method described in previous report (Chen et al., 2025). Three industry experts with extensive professional experience (including one woman with experience in graphic design and two men with extensive experience in advertising design who are proficient in AI-generated image technology) were then invited to conduct the assessment. Data collected from the questionnaire was converted into radar charts to provide a quick overview of image quality. The evaluation of mascot design quality was based on five core dimensions: visual appeal, character traits, emotional expression, consistency and coherence, and character functionality.

Table 1 Ai-Generated Image Training Course (3 hours)

Topic	Operations	Time(min)
Understanding Stable Diffusion and Generative Models	Model Principles, Platform Introduction, Application Scenarios	30
Prompt Design and Semantic Control	Prompt Structure, Style Control, Semantic Fine-Tuning	60
Implementation: Image Generation and Parameter Adjustment	Image Generation, CFG, Number of Steps, Resolution, and Other Parameter Operations	60
Advanced Applications and Creative Experiments	Multi-Prompt Fusion, Style CONversion, Cross-Module creation	30

4.3.2 Data Analysis

In data analysis, radar charts typically visualize multiple dimensions simultaneously, enabling rapid identification of overall performance strengths. Therefore, after expert evaluation of the data, the author utilized the fmsb package in the R programming (R version 4.5.2) to generate radar charts, allowing readers to quickly grasp the dimensional characteristics of AI-generated imagery doll design.

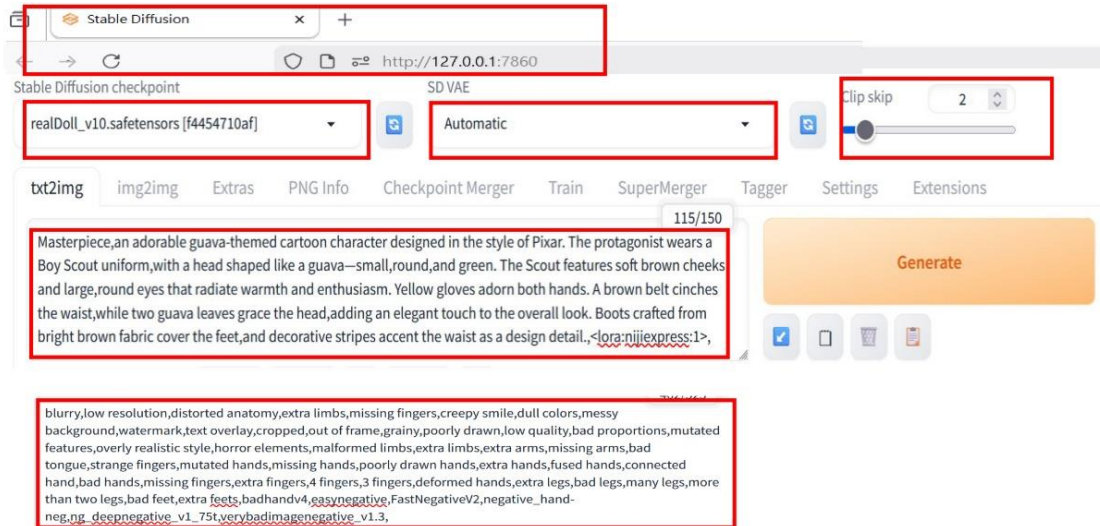
5. Results and Discussion

5.1 Browse the Stable Diffusion Platform and Prompts Training

An effective open-source AI tool for creating images is Stable Diffusion platform. Although the setup and installation process is rather easy, it does require some basic computer knowledge. The basic steps are as follows: Make sure your computer has an NVIDIA graphics card first (at least 8GB of VRAM is recommended). Then opened your browser after the software had started, and typed in <http://127.0.0.1:7860> to access the graphical user interface and started producing (Figure 2). Students were able to design their puppet characters during a three-hour training session by completing assigned tasks and adjusting parameters such as prompt phrases, number of steps, and resolution.

The keywords employed in the model training process have a direct impact on the prompt selection, and various models may employ quite different prompts. The model might not recognize certain keywords, producing results that fall short of expectations. It is advised to consult the Civitai platform's specialized pages for each model, take examples from them, and modify them as necessary. The models (checkpoints) used in this output demonstration were `realDoll_v10` and `disneyPixarCartoon_v10`. These aimed to generate images with two distinct textures: one for the protagonist and another for supporting characters. The primary function of Variational Autoencoders (VAE) was to determine color tones and another details, with the purpose of increasing image saturation and reducing grayscale, thereby adding more color to the image. For VAE, it was recommended to select the automatic option. Next, set the parameter option for Clip (Contrast Language-Image Pre-training) to the number 2 to generate more aesthetically pleasing or creative compositions (Figure 2). By inputting text prompts describing the characteristics of the doll into the SD platform, images of the main character and other characters could be quickly generated, as shown in Figures 4 to 6.

Figure 2 Stable Diffusion Platform Website. Red box showed the URL (topmost). Other parameters demonstrated the checkpoint model as readDoll_v10 (second row, left), VAE (second row, center), Clip model (second row, right), positive prompt input (third row), and negative prompt input (bottom).



Briefly, the prompt structure of Stable Diffusion can be roughly divided into five items (Figure 3), including subject, appearance and action, accessories and clothing, background and composition, style and mood, etc.

For example, the prompts including “guava-themed cartoon character”, “designed in the style of Pixar, protagonist” and “adorable and cheerful” were core characters or objects that define the image, and these keywords belong to the subject category. The authors believed that this classification would help us learn and adjust prompt words more clearly or apply them to different image generation needs. Briefly, the quality of AI-generated images depended directly on how the text prompt was written. By carefully combining descriptive keywords, attributes, and styles within these categories, users can minimize misunderstandings regarding the subject and style of the generated images.

Figure 3 Prompt syntax for Stable Diffusion platform.



5.2 AI-Generated Image Creation Works

After three-hour training, two male and female doll characters, supporting characters, and scene designs that were most popular among students were selected

respectively from the AI-generated doll images, as shown in Figures 4-6. During the AI design and creation training process, students gradually discovered that the results of the drawings were closely related to the prompts they entered, including gender, style, clothing, and scenes.

Briefly, the quality of the AI-generated image on the Stable Diffusion platform is directly influenced by the text prompt's composition. While weighted syntax (e.g., (subject):1.5) highlights significant aspects, the model can concentrate on prominent elements by precisely mixing descriptive keywords, attributes, and stylistic directives—separated by commas. Sharper details and more cohesive compositions are the consequence of reducing token waste and ambiguity through clarity, conciseness, and relevancy (Popovic, 2023). In addition, during the training period, due to the students' unfamiliarity with the prompt words, the initial success rate of generating images was approximately 1/200 to 1/350. However, after continuous training and prompt refinement, the success rate of image generation was improved to between 1 in 100 and 1 in 150, and could even be better. Apart from prompts affecting the quality of AI-generated images, the using of the different checkpoint models also had direct impact.

Figure 4 Character design for the dolls: male protagonist (left) and female protagonist (right), by using the disneyPixarCartoon_v10.



Figure 5 Character design for dolls: male supporting character (left) and female supporting character (right), by using the realDoll_v10 model.



Figure 6 Doll Scene Design, home (left) and school (right), by using the realDoll_v10 model.

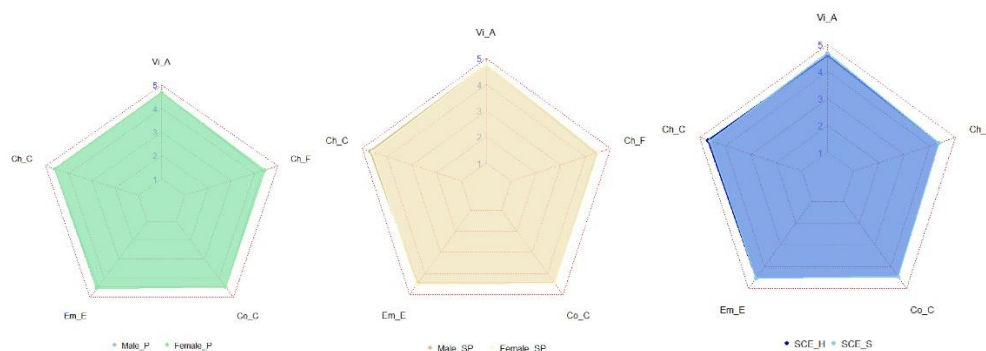
5.3 AI-Generated Doll Work Evaluation

Subsequently, three industry experts were invited to participate in the questionnaire evaluation, with an average professional experience of approximately 17.7 years. Although their average age was 40.3 years old, they were all seasoned designers who had started their own businesses and should be representative of the opinions of artistic creators. The evaluation covered five aspects: 1) visual appeal, 2) character traits, 3) emotional expression, 4) consistency and coherence, and 5) character functionality. The analysis results were then shown in the radar chart (Figure 7). Overall, regarding the creative dolls featuring an agricultural theme (guava), the three design experts unanimously agreed that the main character, supporting characters, and scene settings demonstrated exceptional suitability and creativity, with no significant discrepancies in their evaluations.

However, scores for certain dimensions (such as character functionality) were slightly lower than those for the visual appeal dimension (Figure 7). The authors tentatively proposed the following two possible reasons: 1) The “visual appeal” dimension was intended to assess whether an image features a harmonious color scheme, clear composition, and pleasing visual effects. However, after three hours of training, the instructor had guided students to use variational autoencoders (VAEs) to enhance image saturation, reduce grayscale, and establish color schemes. 2) “Character functionality” should not be limited to a mere pretty picture. In the cited questionnaire items, this dimension was defined as follows: whether the design is suitable for a specific application scenario; whether the character’s actions and poses meet functional requirements; and whether the design meets practical usage needs, such as facilitating the production of derivative merchandise (Chen et al., 2025).

If training sessions were extended to allow participating students greater familiarity with the SD platform's operations, there would be potential for even more creative and unexpected outcomes.

Figure 7 Evaluation of AI-generated Doll design. Y-axis value: mean, Left: Male and Female characters, Center: Supporting role (MS: male supporting, FS: female supporting), Right: Scene modeling (Home and School scene), Vi_A: visual appeal, Ch_C: character characteristics Em_E: emotional expression, Co_C: consistency and coherence, and Ch_F: Character function. (Radar plot prepared by using R version 4.5.2 programming)



6. Conclusion, Implication and Future Research

This study demonstrates that artificial intelligence-generated image technology, particularly Stable Diffusion, can effectively support doll design education while promoting Taiwanese agricultural products. Through a three-hour structured training program, the students successfully created a series of mascots that blend cultural stories with visual appeal, overcoming the traditional challenges of limited artistic skills and insufficient class time, and demonstrating a learning process that effectively stimulates student creativity. Expert evaluations confirmed that the AI-generated dolls exhibited strong coherence, emotional resonance, and functional qualities, highlighting the importance of prompt refinement and iterative practice. The data indicated that AI-generated image technology is not only a valuable tool for assisting human creativity but can also serve as an educational tool to enhance students' learning efficiency, motivation, and innovative capabilities in design classes. If the agricultural theme was further incorporated into mascot design, we can also highlight the potential of AI in strengthening local brand identity and cultural identity through design.

To further deepen these research findings, future comparative studies are recommended to explore more specific directions. For example, how do AI-generated mascot designs differ from those created by human professionals in terms of brand image building and market acceptance? At the same time, the long-term impact of AI-generated image technology (AIGIT) on students' creative thinking will be further evaluated by extending the duration of training.

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