Leveraging Generative AI for Strategic Design Visualization and Innovation in Early-Stage of Product Development Among Students

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ABSTRACT

Generative models in Artificial Intelligence (AI), such as Stable Diffusion and ChatGPT, are increasingly employed across diverse fields, including product design, for tasks like shape recognition and design creation. The convergence of physical and digital realms is emerging as a prominent trend in art and design. This trend underscores generative models' ability to bridge offline and online environments in creative endeavours. This article aims to investigate the potential of integrating generative image AI into a strategic design visualization process among product design students. Using image-based research analysis and semi-structured interviews, this study involved five product design students as respondents. The findings highlight that integrating generative AI tools, particularly the Copilot Bing Image Creator, significantly enhances product design education. It improves students' creativity and streamlines the design process. This integration not only closes the gap between creative concepts and practical applications but also offers a robust framework for evaluating AI-generated content. Ultimately, it enhances the quality, practicality, and comprehension of design processes among students. This study underscores the transformative potential of generative AI tools in strategic design process, showcasing their effectiveness in fostering creativity, efficiency, and design quality.

Keywords: Strategic Design, Product Design, Artificial Intelligence, Visualization.

INTRODUCTION

Ye et al. (2024) describe generative AI as a data-driven method that produces synthetic artefacts by learning patterns from training datasets and generating realistic text, graphics, audio, and video. Unlike traditional programming, it creates new content through pattern learning. Recent multimodal models such as Stable Diffusion and DALL·E now allow non-experts to produce high-quality images through simple text prompts, while language models like GPT demonstrate strong conversational and reasoning abilities (Tian et al. 2024).

Generative AI's strength lies in its flexible modelling and ability to produce designs informed by embedded real-world knowledge (Hashmi & Bal 2023). It reduces reliance on traditional computational methods while increasing design diversity and creativity. Its role in data visualization has also expanded, supporting data processing, mapping, automatic visualization generation, and inference (Yang et al. 2019). Earlier visualization systems relied on rule-based methods (Chen et al. 2009), but generative models overcome these limitations by learning visual and structural principles directly from data.

In product design education, key competencies include design thinking, user research, ergonomics, market awareness, prototyping, and user experience (Huang et al. 2024). Within design thinking, the ideation stage is vital for integrating logical reasoning with emotional expression (Abdullah Sani et al. 2019; Chumiran, Abidin, and Kamil 2020; Kamil and Abidin 2013; Kamil, Abidin, and Hassan 2019a, 2019b; Kamil, Zainal Abidin, and Hasdinor Hassan 2018; Li and Mohamed Kamil 2022; Mohamed Kamil et al. 2024; Mohamed Kamil and Abdullah Sani 2021; Mohamed Kamil, Ho Wan Ying, and Abdullah Sani 2022; Mohamed Kamil, Hua, and Abdullah Sani 2022; Mohamed Kamil and Shaukat 2023; Mohamed Kamil and Zainal Abidin 2015; Sani et al. 2020). Traditionally, ideation depends on hand sketches or CAD tools, and many scholars have examined how these media influence creativity (Jonson 2005; Self, Evans & Kim 2016; Nelson et al. 2009; Chien et al. 2022).

Recent developments indicate a shift toward generative AI for semantic conceptualization and visual generation. Text-to-image systems now allow designers to input product features and instantly obtain visual concepts (Huang et al. 2024). This improves efficiency, broadens creative exploration, and supports more innovative idea development. Huang et al. (2024) identify two key roles of generative AI in product design: (1) intelligent chatbots that function as on-demand domain experts and (2) advanced concept visualization tools. Together, these functions are reshaping design education by improving creativity, workflow speed, and design quality.

In contemporary design discourse, AI is increasingly understood not only as a visualization tool but also as a strategic epistemological approach that supports cognitive and interpretive aspects of design. Buchanan (2001) argues that design constructs meaning within symbolic and functional systems. Generative AI aligns with this view by externalizing abstract intentions through natural language and imagery, translating ambiguous concepts into speculative, interpretable visuals.

This capability supports design futures, which emphasize exploring multiple trajectories of change (Candy & Dunagan 2017). Generative AI enables rapid prototyping of possible, probable, and preferable scenarios through low-fidelity yet semantically rich artefacts. These serve as prompts for reflection, allowing designers to examine emerging socio-technical values and implications. Through iterative exploration, AI becomes a partner in constructing value propositions, strengthening early-stage innovation and strategic foresight.

Prompt engineering further shapes this collaboration. Short and Short (2023) define it as refining inputs to obtain specific outputs, essentially determining "how to talk to AI to get it to do what you want." Carefully constructed prompts enable designers to guide AI toward outputs that align with conceptual, functional, and ethical intentions (Tian et al. 2024). In this way, concept design becomes a proposition-building process where linguistic cues help materialize intangible ideas.

This article examines how generative AI can strategically enhance design visualization and innovation in early-stage product development among students. By integrating AI-generated imagery into ideation, the study explores how these tools support rapid, experimental, and informed concept exploration. The study positions AI not only as a visual aid but as a driver of strategic design thinking, helping students visualize form and function while reflecting on user needs, contextual relevance, and technological feasibility. Through this lens, generative AI operates as a catalyst for future-oriented, system-aware, and value-driven design practice.

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1. THE ROLE OF COPILOT BING IMAGE CREATOR AS A GENERATIVE AI PLATFORM

Copilot Bing Image Creator, developed by Microsoft and powered by OpenAI's DALL·E 3, marks a significant step in generative visual media. As a text-to-image system integrated within the Microsoft Copilot ecosystem, it democratizes high-quality image creation through natural language prompts and an intuitive web interface, extending its utility beyond standalone platforms such as Midjourney or Stable Diffusion (Microsoft 2023).

Designed for accessibility and rapid outputs, Copilot removes many technical barriers associated with earlier AI tools that required specialized skills or local model installation. Cloud-based processing, simple navigation, and integration with Microsoft accounts make it widely usable, especially for non-experts. These features reflect what Hutchby (2001) describes as technological affordances that shape user engagement across cultural and educational contexts.

Visually, Copilot produces images that go beyond literal prompt interpretation, offering coherent composition and stylistic clarity. Baetens (2013) argues that digital platforms construct "visual regimes," meaning AI imagery reflects cultural and design assumptions embedded in training data. Compared with the stylized tendencies of Midjourney, Copilot's DALL·E 3 prioritizes realism and interpretability (OpenAI 2023).

The tool builds on developments in Generative Adversarial Networks (GANs) and diffusion models, evolving from earlier transformer-based systems like DALL·E 2 (Ramesh et al. 2022). While open-source alternatives such as Stable Diffusion offer greater customization, Copilot emphasizes ease of use, making it suitable for education and design prototyping where speed and low technical overhead are essential.

In visual ideation, Copilot supports non-linear and iterative workflows, enabling rapid exploration and externalization of abstract ideas. This aligns with Manovich's (2013) view that contemporary creative practices are shifting from image manipulation to image generation, signalling a broader transformation in how visual content is conceptualized and produced.

2. METHODOLOGY

The study aimed to examine how generative AI can support product designers in enhancing innovative elements within product design visualizations. Using purposive sampling as recommended by Guest, Bunce, and Johnson (2006), five product design students were recruited for a controlled experiment conducted at the Faculty of Applied and Creative Arts, Universiti Malaysia Sarawak. Each session, lasting approximately 70 minutes, consisted of three phases.

Table 1: Respondents' demographic data

Index	Gender	Age	Degree level	Program	Year of Study
Respondent 1	Male	20	Bachelor's degree	Design Technology (Product Design)	2
Respondent 2	Female	22	Bachelor's degree	Design Technology (Product Design)	3
Respondent 3	Male	19	Bachelor's degree	Design Technology (Product Design)	1
Respondent 4	Male	21	Bachelor's degree	Design Technology (Product Design)	3
Respondent 5	Female	20	Bachelor's degree	Design Technology (Product Design)	2

2.1. Phase 1: Briefing Session

Phase 1 involved a 20-minute briefing to familiarize respondents with the study workflow and the basic principles of prompt construction. Participants received written instructions explaining how to formulate prompts for Copilot Bing Image Creator. They were also given three sketches of daily-use products: (1) a toaster; (2) a computer mouse; and (3) a hair dryer. They were asked to study these sketches, focusing on identifying design criteria that could enhance the innovative elements of each product, and brainstormed the suitable prompt.

To ensure methodological consistency, a standardized prompt structure was used (see Table 2), requiring respondents to construct prompts around three elements: (1) the subject, (2) the innovative features, and (3) the intended style. Initially, respondents need to properly describe the subjects under study (e.g., toaster design on the kitchen cabinet), then elaborate the innovative descriptions desired for the subject (e.g., compartment for fruit, honey jam, butter compartment, and portable design) and incorporate the intended product's style/features (e.g., Contemporary design). Finally, based on the sketches given as a reference image, the description of the three elements will be combined into full sentences prompt. This structured format aimed to maximize variability in prompt construction but in the same time ensuring that the AI-generated outcomes could be more accurately attributed in the mode of hyper realistic photography.

Table 2: Sample of prompt generation based on the three elements.

The Subject	Toaster design on the kitchen cabinet
The Innovative Descriptions	Compartment for fruit, honey jam, butter compartment, and portable design
The product's style/features	Contemporary design
Full Sentences Prompt	Toaster design on the kitchen cabinet; innovative feature of compartment for fruit, honey jam, and butter compartment, portable design; in design style of contemporary design.

2.2. Phase 2: Generating Images

In Phase 2, respondents participated in a 30-minute image generation session using Copilot Bing Image Creator (https://copilot.microsoft.com/). The first step involved writing the prompt in the space provided in the Copilot Bing Image Creator (marked with red box in Figure 1) based on three elements: (1) the subject, (2) the innovative descriptions, and (3) the product's style. The next step is uploading the given image in Copilot Bing Image Creator (marked with red box in Figure 2) by clicking the button 'Add an Image'. The prompt and the uploaded image were then applied as an input in Copilot Bing Image Creator to generate the intended images (Figure 3). Given the iterative nature of the design process, respondents were permitted a maximum of five prompt refinement cycles to optimize their image generation efforts and arrive at a satisfactory final design within 30 minutes. This structured limit encouraged participants to think critically about their prompt strategies while promoting efficient use of the generative AI tool. Throughout the process, all inputs including finalized prompt texts and the final selected AI-generated image were documented.

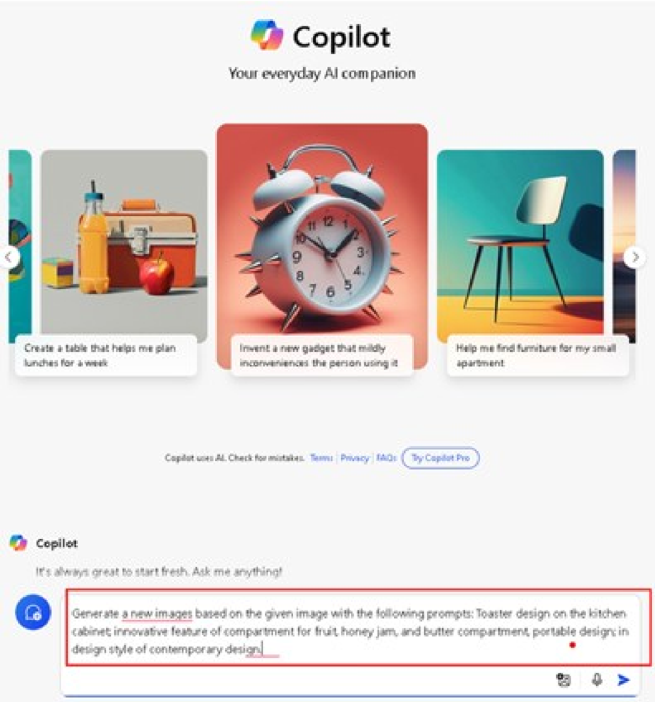

Figure 1. Writing the prompt in the space provided in the Copilot Bing Image Creator

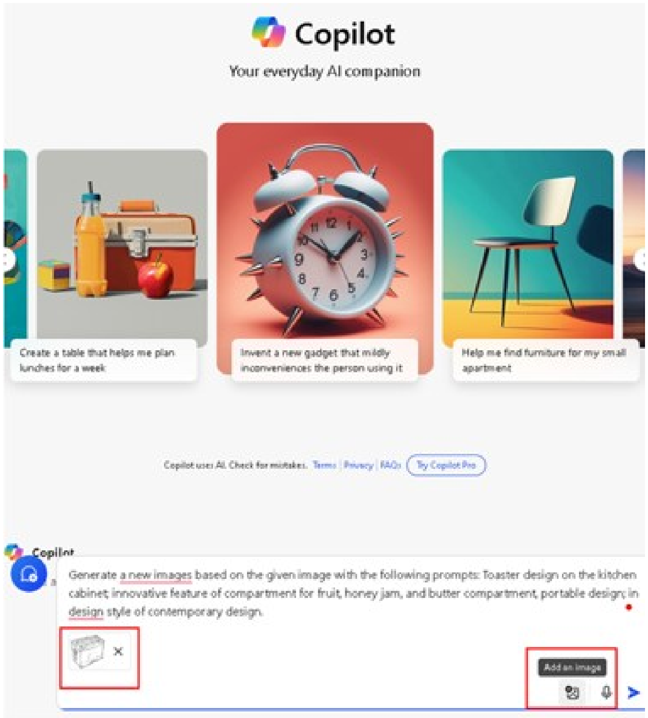

Figure 2. Uploading the given image in Copilot Bing Image Creator

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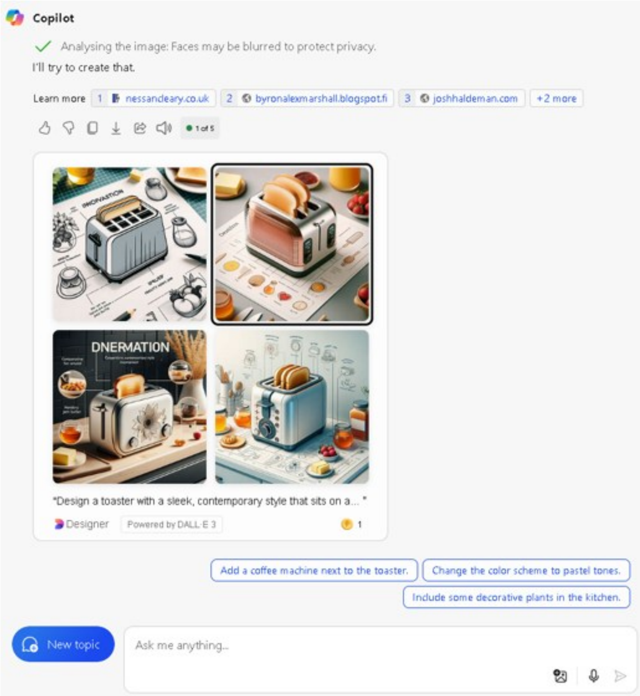

Figure 3. Generated images by Copilot Bing Image Creator

The analysis of generated images followed frameworks by Mason (2005) and Burri (2012). Mason's image-based research approach guided descriptive observations and systematic presentation of image plates, while Burri's three visual dimensions structured the evaluation: (1) visual value: non-verbal characteristics and visual information density; (2) visual performance: organization and representation of visual signs; and (3) persuasive visuality: the rhetorical and communicative strength of the images. Thus, this study organizes its analytical framework into three sections based on these perspectives: (1) analysing the generated AI images through the lens of the visual value dimension; (2) examining the input prompt's impact on visual composition through the visual performance dimension; and (3) evaluating the synthesis of prompts in terms of the image's persuasive visual dimension (see Table 3).

Table 3: Sample of image-based analysis

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 2	'Toaster design on the kitchen cabinet; innovative feature of compartment for fruit, honey jam, and butter compartment, portable design; in design style of contemporary design.'	Subject: Toaster design on the kitchen cabinet Description: Compartment for fruit, honey jam, butter compartment, and portable design Style/Aesthetic: Contemporary design	

2.3. Phase 3: Debrief Interview Session

Phase 3 consisted of a 20-minute debrief interview to capture respondents' reflections on both the briefing and image generation stages. The interviews explored clarity of instructions, experiences in prompt creation, use of Copilot Bing Image Creator, and perceptions of how innovative features were reflected in the outputs.

Interview data were analysed using Creswell (2009) and Saldaña's (2009) three-step coding process: open, axial, and selective coding. Open coding identified initial conceptual labels from respondents' statements. Axial coding grouped related codes into broader categories, and selective coding refined these categories to identify core themes most relevant to the study's objectives. For instance, in a study aimed at determining respondents' experiences during the briefing session (see Table 4), the researcher employed open coding, which involves labelling and analysing features of respondents' speech. The components of the respondents' speech were then separated and categorized by the researcher. To create more conceptual categories, the open codes were abstracted into axial codes. Through selective coding, similar coded data were grouped into conceptual categories derived from the open codes. Codes were reorganized iteratively to ensure conceptual coherence, following Muller and Kogan's (2012) recommendation to develop categories aligned with emerging analytical priorities. This process may need to be repeated several times to establish the relationship between the codes and develop the most plausible explanation.

Table 4: Sample of coding on three respondents' experiences during the briefing session

ID	Protocol Time	Transcriptions	Attributes	Open Codes: Categories of information	Axial Codes	Selective Codes
Respondent 1	05:18	"The briefing was very thorough. The instructions on how to generate and use prompts were clear, and the examples really helped me understand the process."	Briefing was very thorough The instructions were clear The examples are good	The respondent had a thorough briefing, clear Instructions, and good examples during the briefing session	Respondents' experience during the briefing session is considered good due to a thorough briefing, clear instructions, and good examples during the briefing session	Respondents' experiences during the briefing session were considered positive due to the thoroughness of the briefing, the clarity of instructions, the quality of examples provided, the de-tailed guidance on using Copilot Bing Image Creator, and the overall effectiveness of the briefing content and demonstrations.
Respondent 2	03:41	"I appreciated the detailed document provided. The step-by-step guidance on using Copilot Bing Image Creator was especially helpful."	The document is detailed The guidance of using Copilot Bing Image Creator is effective	Respondent had a good guidance on Copilot Bing Image Creator with detailed document	Respondents' experience during the briefing session is considered good due to a good guidance on Copilot Bing Image Creator with detailed document.	
Respondent 3	07:25	"I found the session quite informative. It was my first time working with generative AI, and the demonstrations made it much easier to grasp."	The briefing was informative The demonstration is effective	The briefing and demonstrations help the respondent.	Respondents' experience during the briefing session is considered good due to the effectiveness of briefing content and demonstrations	

3. DATA FINDINGS AND DISCUSSION

The findings from Phase 2 are presented to provide qualitative insight into the AI image generation process. The generated images were analysed through descriptive observations supported by systematically arranged image plates. Each image was annotated to highlight key visual and functional attributes, focusing on how accurately the AI interpreted the design prompts. These observations revealed recurring patterns in the outputs, including the integration of innovative features, the degree of stylistic adherence, and the overall coherence of the visual compositions.

The analysis was further enriched by examining the prompts used during image generation. The prompts served as a basis for understanding how subject descriptions, functional elements, and stylistic cues shaped the AI's interpretive behaviour. Comparing images across

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similar prompts enabled the identification of consistent tendencies and notable variances in the AI's translations of user intent.

Particular attention was given to how innovative design features were represented such as ergonomic enhancements, interactive elements, and portability improvements. These features were assessed for both visual clarity and functional plausibility. The insights gained offer a clearer understanding of the capabilities and limitations of generative AI in product design applications. They also illustrate how such tools can extend beyond conventional design workflows, opening new opportunities for creativity, rapid visualization, and design customization.

3.1. The generated AI image of toaster design

Respondent 1 integrates the prompt with interactive display functions, proposing a suggestion-based toasting menu within a Bauhaus-inspired minimalist form (Table 5). The design successfully reflects user-centred simplicity and the Bauhaus principle of "*form follows function*". However, several limitations emerge. The interface contains unreadable or nonsensical text which reducing realism and usability. The inability to render legible or meaningful typography, especially in UI mock-ups is an ongoing issue in AI-generated UI elements. While the composition, lighting, and textures appear polished, Copilot tends to prioritise visual appeal over functional accuracy, illustrating its bias toward aesthetic coherence rather than semantic precision.

Table 5: Findings of image-based analysis (toaster design) from the outcomes of Respondent 1

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 1	'Imagine a high realistic toaster design on the table in the kitchen; innovative feature of interactive display with suggestion toasting menu, easy to carry; in design style of Bauhaus'	Subject: Toaster design on the table in the kitchen Description: Interactive display with suggestion toasting menu Style/Aesthetic: Bauhaus	

Respondent 2 adopts a modern, portable concept featuring compartments for different spreads. Copilot translates the prompt into a clean, compact design with consistent form, materials, and lighting (Table 6). Yet the compartment concepts for the various spreads were not successfully illustrated. Furthermore, the text elements in the digital screen are nonsensical. As with Respondent 1, illegible text disrupts the interface's communicative function, demonstrating the model's continued difficulty with generating meaningful typography.

Table 6: Findings of image-based analysis (toaster design) from the outcomes of Respondent 2

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 2	'Toaster design on the kitchen cabinet; innovative feature of compartment for fruit, honey jam, and butter	Subject: Toaster design on the kitchen cabinet Description: Compartment for fruit, honey jam, butter compartment, and portable design	

		compartment, portable design; in design style of contemporary design.’	Style/Aesthetic: Contemporary design	

Respondent 3 employs a futuristic aesthetic, foregrounding smart-home features such as a digital timer, temperature controls, and safety mechanisms. The output demonstrates strong visual coherence, with metallic finishes, neon accents, and a rich sci-fi style. The interface appears detailed and intuitive at first glance, but closer inspection reveals illegible text and excessive button density, indicating an overemphasis on visual spectacle rather than ergonomic logic. These flaws highlight Copilot’s limitation in modelling human-centred interaction, reinforcing the need for designers to interpret and refine AI-generated concepts for real-world feasibility.

Table 7: Findings of image-based analysis (toaster design) from the outcomes of Respondent 3

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 3	‘Toaster design on dining table; innovative feature of user-friendly timer and temperature adjuster, safety elements; in design style of futuristic design’	Subject: Toaster design on the dining table Description: User-friendly timer and temperature adjuster, equipped with safety elements Style/Aesthetic: Futuristic design	

Respondent 4 focuses on multi-bread compatibility and advanced touchscreen controls (Table 8). The generated image effectively illustrates a retro-futuristic design language with glowing UI elements and a cohesive colour palette. However, text-rendering issues persist, and the interface is visually dense to the point of information overload. While Copilot excels in producing imaginative sci-fi aesthetics, it lacks semantic precision and ergonomic sensibility, again showing its strength in ideation but weakness in functional detailing.

Table 8: Findings of image-based analysis (toaster design) from the outcomes of Respondent 4

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 4	‘Toaster design on design studio pantry; innovative feature of having toast space for multiple types of breads such sourdough and baguette, safety timer controller, touch screen; in design style of futuristic design’	Subject: Toaster design on design studio pantry Description: Toast space for multiple types of breads such sourdough and baguette, safety timer controller, touch screen Style/Aesthetic: Futuristic design	

Respondent 5 references the Zaha Hadid design language, incorporating curved geometries, a wireless timer, and touchscreen interface (Table 9). Although the output reflects a minimalist modern aesthetic with cultural contextual depth in the background setting, it does not fully capture Hadid’s radical formal dynamism. Text and icons remain generic or indecipherable, revealing Copilot's continued struggle with semantic clarity. Furthermore, key mechanical aspects such as the feasibility of wireless control are not articulated, emphasizing the model's tendency to privilege surface aesthetics over functional realism.

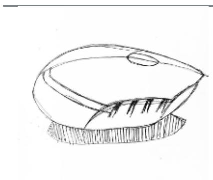
Table 9: Findings of image-based analysis (toaster design) from the outcomes of Respondent 5

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 5	'Toaster design on Chinese dining table; innovative feature of wireless timer controller, remote control screen; in design style of Zaha Hadid de-sign'	Subject: Toaster de-sign on Chinese dining table Description: Wireless timer controller, remote control screen Style/Aesthetic: Zaha Hadid design	

3.2. The generated AI image computer mouse design

Respondent 1 aims to integrate ergonomic shaping and sensor-based colour cues within a DC-inspired superhero theme. However, the generated output features Marvel characters such as Iron Man, Spider-Man, and Captain Marvel, indicating a mismatch between the intended reference and Copilot's interpretation (Table 10). Ergonomic elements such as button placement, contoured grip, and thumb support are rendered convincingly, suggesting suitability for gamers or young adults. While the bold colours and action-driven graphics create visual excitement, the dominance of printed imagery risks obscuring functional indicators and reducing long-term durability. Copilot demonstrates strong rendering of materials and lighting, yet reveals limitations in brand recognition, typographic fidelity, and conceptual alignment. Overall, the design shows strong ideation potential but requires refinement to balance visual storytelling with practical usability.

Table 10: Findings of image-based analysis (computer mouse design) from the outcomes of Respondent 1

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 1	'Computer mouse on the table; have innovative features ergonomic handling, sensor colour variations, in design style of DC superheroes	Subject: Computer mouse on the table Description: Ergonomic handling, sensor col-our variations Style/Aesthetic: DC superheroes	

Respondent 2 references the De Stijl movement, combining geometric abstraction with wireless functionality, ergonomic form, and colour-responsive sensors (Table 11). Although the output features intersecting lines, modular shapes, and bold colour fields, it departs from De Stijl's strict geometric discipline and primary colour palette. This suggests a partial misalignment between conceptual intent and visual execution. Despite the stylistic deviation, the design maintains a clear visual identity that may appeal to younger or design-oriented users. Copilot performs well in material rendering and graphic placement on curved forms yet struggles to accurately capture the philosophical rigor of historical art movements. The resulting design is visually engaging but relies more on vibrancy than adherence to De Stijl principles.

Table 11: Findings of image-based analysis (computer mouse design) from the outcomes of Respondent 2

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 2	'Computer mouse on the gaming table; have an innovative features wireless technology, ergonomic handling, sensor colour variations, in design style of De Stijl movement'	Subject: Computer mouse on the gaming table. Description: wireless technology, ergonomic handling, sensor color variations Style/Aesthetic: De Stijl movement	

Respondent 3 prioritizes ergonomic comfort and wireless capability, adopting a bold, aggressive aesthetic characterized by sharp contours and red lighting (Table 12). The output strongly aligns with gaming peripheral conventions, combining cohesive grip textures, button placement, and illuminated accents. While effective for the gaming niche, the emphasis on dramatic lighting may limit broader market appeal. This reveals Copilot's tendency to amplify stylistic cues at the expense of functional neutrality. Even so, the design successfully captures a futuristic, performance-driven character consistent with contemporary gaming trends.

Table 12: Findings of image-based analysis (computer mouse design) from the outcomes of Respondent 3

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 3	'Computer mouse on the table in design studio; have an innovative features sensor menacing color, wireless technology, ergonomic handling; in design style of menacing red"	Subject: Computer mouse on the table in design studio Description: sensor menacing color, wireless technology, ergonomic handling Style/Aesthetic: Menacing red	

Respondent 4 presents a mouse concept grounded in ergonomic shaping, wireless use, and the vivid visual language of advanced warfare gaming (Table 13). RGB lighting, gradient effects, and circuit-like graphics create a technologically immersive aesthetic that resonates with gaming audiences. The consistency between visual style and functional intent supports user expectations for personalized gaming accessories. However, the intensity of these visual effects may lead to sensory fatigue or misalign with the original design intent, reflecting Copilot's inclination toward hyper-stylized outputs. Despite this, the tool proves effective for early-stage exploration and pushing the boundaries of visual experimentation.

Table 13: Findings of image-based analysis (computer mouse design) from the outcomes of Respondent 4

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 4	'Computer mouse on the gaming table; have an innovative features wireless	Subject: Computer mouse on the gaming table Description: wireless technology, ergonomic design, futuristic colors	

		technology, ergo-nomic design, futuristic colors, in design style of Advance Modern Warfare"	Style/Aesthetic: Advance Modern Warfare	

Respondent 5 envisions an ergonomic wireless mouse infused with Art Nouveau influences and subtle Chinese decorative cues, including patterned ceramics and a symmetrical table arrangement (Table 14). Disco-inspired colour accents add a contemporary twist, resulting in a culturally eclectic visual composition. While the concept aims to merge ornamentation with modern usability, the Art Nouveau elements appear simplified, lacking the signature organic curves and intricate linework of the movement. The inclusion of tableware and food elements shifts the composition toward a lifestyle scene, distracting from product clarity. This highlights Copilot's tendency to prioritize atmospheric or thematic scenes over focused design representation. Nevertheless, the output supports exploratory ideation by enabling rich visual narratives that may be challenging to traditional visualization process.

Table 14: Findings of image-based analysis (computer mouse design) from the outcomes of Respondent 5

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 5	'Computer mouse on the Chinese in-spired table; have an innovative features ergonomic handling, wireless, disco color; in design style of Art Nouveau movement'	Subject: Computer mouse on the Chinese inspired table Description: ergonomic handling, wireless, disco color Style/Aesthetic: Art Nouveau movement	

3.3. The generated AI image hair dryer design

Respondent 1 applies Bauhaus principles to develop a hair dryer that emphasizes simplicity and functional clarity. The minimalist silhouette, matte finish, and circular interface echo Bauhaus geometry, while the touch-sensitive base enhances user interaction (Table 15). However, the bulky docking base may reduce portability and spatial efficiency. The concept demonstrates Copilot's strength in supporting structured design ideation, while also revealing its limitations in addressing ergonomic compactness.

Table 15: Findings of image-based analysis (hair dryer design) from the outcomes of Respondent 1

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 1	'Hair dryer design on the dressing table; innovation feature of interactive display	Subject: Hair dryer design on the dressing table Description: Interactive display with adjustment menu, easy to carry	

		with adjustment menu, easy to carry; in design style of Bauhaus’	Style/Aesthetic: Bauhaus	

Respondent 2 blends 1990s women’s fashion with futuristic elements, producing a hair dryer that fuses nostalgic charm with digital innovation (Table 16). Soft metallic tones, rounded edges, and retro-futuristic typography reinforce the intended aesthetic. The foldable menu screen enhances user engagement, though reliance on a wall-mounted interface restricts portability and suggests semi-permanent usage. The design showcases Copilot’s ability to merge nostalgic cues with modern features yet highlights its limitations in accounting for diverse user contexts.

Table 16: Findings of image-based analysis (hair dryer design) from the outcomes of Respondent 2

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 2	'Hair dryer design in the hotel living room; innovation feature of foldable and interactive screen menu; in design style of 90's ladies’	Subject: Hair dryer design in the hotel living room. Description: foldable and interactive screen menu Style/Aesthetic: 90's ladies	

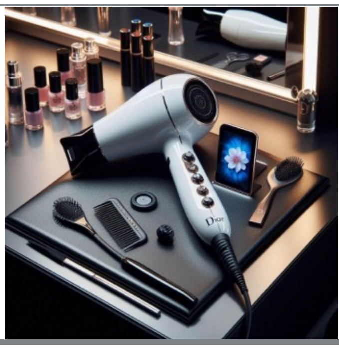
Respondent 3 incorporates Gucci-inspired luxury elements, including monogram patterns, gold accents, and the iconic green-red stripe, to create a fashion-driven hair dryer concept (Table 17). Although the visual branding is consistent, the adjustable and foldable features described in the prompt were not represented. This underscores Copilot’s tendency to privilege surface aesthetics over functional detail, revealing challenges in balancing high-fashion styling with user-centred ergonomics.

Table 17: Findings of image-based analysis (hair dryer design) from the outcomes of Respondent 3

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 3	‘Hair dryer de-sign on the table; innovation feature of adjustable function, foldable design; in de-sign style of Gucci’	Subject: Hair dryer design on the table Description: Adjustable function, foldable de-sign Style/Aesthetic: Gucci	

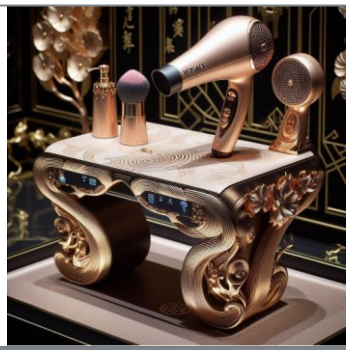
Respondent 4 takes inspiration from Dior, emphasizing sleek elegance through a monochromatic palette, polished finishes, and metallic controls (Table 18). The design includes an interactive screen to enhance the premium user experience. While visually cohesive, the practicality of the interface placement raises ergonomic concerns, and the foldable feature requested in the prompt is absent. The output demonstrates Copilot's strength in visual brand alignment but highlights its limited sensitivity to detailed functional requirements.

Table 18: Findings of image-based analysis (hair dryer design) from the outcomes of Respondent 4

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 4	'Hair dryer de-sign on the make-up table; the hair dryer is foldable, has an interactive screen; in design style of Dior'	Subject: Hair dryer design on the make-up table Description: foldable, has an interactive screen Style/Aesthetic: Dior	

Respondent 5 integrates the lavish aesthetic of Versace into the hair dryer design, incorporating intricate gold motifs and sculptural elements to create a lavish hair dryer concept (Table 19). Although the branding is strong, the elaborate design may compromise portability and daily usability. Features such as foldable components and interactive screens were also not illustrated. This reflects Copilot's capability to generate bold, brand-consistent imagery, while exposing challenges in balancing decorative richness with ergonomic practicality necessary for everyday products.

Table 19: Findings of image-based analysis (hair dryer design) from the outcomes of Respondent 5

Sample of Sketches	ID	Input Prompt	Prompt Synthesis	Generated Image
	Respondent 5	'Hair dryer de-sign on the Chinese in-spired make-up table; innovative features of foldable design with interactive function screen; in design style of Versace'	Subject: Hair dryer on the Chinese inspired make-up table Description: foldable, has an interactive function screen Style/Aesthetic: Versace	

Overall, each respondent's prompt followed a structured format that included a clear subject focus (e.g., a toaster on a table), detailed functional features (such as an interactive toasting display), and an aesthetic indicator that defined the desired design style (e.g., Bauhaus or contemporary). This structure enabled the AI to interpret and synthesize the prompts more effectively. The prompts also demonstrated a wide range of design aesthetics, spanning historical art movements like Bauhaus and Art Nouveau to modern and futuristic concepts. Although the accuracy of stylistic representation remained limited, this variety illustrates the AI's flexibility in adapting to diverse visual languages and producing stylistically varied outputs. Additionally, a recurring emphasis on innovative features such as interactive displays, ergonomic wireless mouse designs, and foldable or multifunctional hair dryers has highlighted the respondents' focus on integrating contemporary functionalities into AI-generated product concepts.

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3.4. Respondents' experiences during Phase 2

Based on the debrief interviews, respondents shared diverse experiences regarding the prompt creation process and their use of Copilot Bing Image Creator. Crafting prompts was described as intellectually stimulating yet demanding, as respondents needed to express design intentions with clarity and precision. Many initially struggled to translate abstract ideas into effective textual prompts, but iterative refinement helped them better understand how to communicate their design visions strategically.

Overall, Copilot Bing Image Creator was positively received for its responsiveness and its ability to transform textual input into visually compelling and contextually relevant imagery. Despite some inconsistencies, respondents praised the tool's efficiency and the generally high fidelity of its outputs, noting that many generated images aligned with their intended concepts. The tool's iterative capability was particularly valued, enabling users to test prompt variations, explore alternative interpretations, and improve the accuracy of visual outcomes.

Respondents also viewed the embedded design features in the AI-generated images favourably. These outputs were regarded as both aesthetically strong and functionally meaningful, demonstrating the tool's potential to visualize innovative product ideas. Overall, the experience highlighted Copilot's value as a design support tool, helping bridge the gap between conceptual ideation and visual prototyping within a digitally mediated creative workflow.

4. CONCLUSION

This research examined the use of generative AI, specifically Copilot Bing Image Creator, as a strategic visualization tool in the product design process among students. The findings highlight how AI can foster creativity, support innovation, and enhance higher-level strategic functions within design education. The study emphasized the importance of a comprehensive briefing session that equipped respondents with essential knowledge for interacting with AI tools. Clear instructions and demonstrations were crucial in preparing participants, ensuring meaningful and productive engagement. This underscores the value of initial preparation in maximizing the strategic potential of AI in educational settings. Respondents' experiences during prompt creation reflected the iterative and reflective nature of designing with AI. Many initially found it challenging to articulate abstract ideas, yet through repeated refinement they developed stronger prompt-engineering skills. This process supported idea generation and enabled students to externalize intentions, clarify functional goals, and construct value-driven design narratives. Such outcomes demonstrate AI's role not only in stimulating creativity but also in supporting strategic meaning-making and future-oriented thinking. Copilot Bing Image Creator effectively produced visual outputs that captured both functional and aesthetic qualities. Its ability to integrate elements such as interactive displays, ergonomic features, and foldable mechanisms showed how AI can link conceptual ideas with practical considerations, reinforcing its function as a strategic collaborator in the design process. The study also highlighted the usefulness of visual analysis frameworks (the visual value, visual performance, and persuasive dimensions) in interpreting AI-generated content. These layers of analysis helped reveal how AI outputs communicate form, intention, emotional tone, and user-centric value. This approach positions AI as more than an image generator; it becomes a contributor to systemic design strategies that connect aesthetics with usability, desirability, and cultural significance. In conclusion, integrating generative AI in product design education offers

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benefits beyond creative enhancement. It strengthens strategic design thinking, supports the development of compelling value propositions, and enables speculative exploration through accessible visualization tools. The iterative prompt-development process, supported by clear instructional guidance, cultivates not only creative fluency but also strategic competence. This study provides a foundation for future research and pedagogical practice, offering educators a pathway to equip students with the technical, visual, and strategic skills necessary for innovation in product development.

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