



A comparative evaluation of visual accuracy in AI-Generated botanical illustrations

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Abstract.

Generative Artificial Intelligence (GenAI) technology is now one of the most widely used tools for producing creative content, including text, images, sound, and video. GenAI represents a breakthrough in both art and education, particularly in aiding the creation of illustrations. Traditionally, producing scientific illustrations requires a high level of accuracy and adherence to established scientific standards. This challenge has prompted researchers to analyze the effectiveness of GenAI in supporting the creation of scientific illustrations, with a specific focus on botanical illustrations. The purpose of this research is to evaluate the accuracy of GenAI-generated botanical illustrations. This study employs a descriptive qualitative method with an experimental approach, specifically testing the application of GenAI to generate botanical images using four GenAI platforms. The resulting illustrations from these four platforms are then visually compared, evaluated, and validated by a botanical illustration expert. The results indicate that GenAI has potential for botanical illustration, especially as a source of inspiration for exploring different illustration styles, but it is still unable to consistently produce accurate scientific representations. The results also show differences in the accuracy and quality of the generated illustrations among the selected plants, which can lead to anatomical distortions or unrealistic features, highlighting the need for expert validation and careful selection of illustration styles.

Keywords: Generative Artificial Intelligence; GenAI; Scientific Illustration; Botanical Illustration

Introduction

Scientific illustration refers to illustrations used to accompany scientific works. It has a long history in its role as a communication tool for the dissemination of science (Escardó & Wiedemann, 2022). A scientific illustrator, or SciArtist, must be skilled in translating scientific ideas and concepts into visuals, communicating hypotheses, and inspiring the public through scientific illustration (Iwasa, 2016). However, because scientific illustrations require a high degree of accuracy, botanical illustrations generated with GenAI tools must be evaluated to determine their potential and whether they meet scientific standards. Moreover, photography has not completely replaced illustration. Scientific illustration must depict ideal specimens that cannot be captured in photography (Rykaczewski, 2021). In the case of botanical illustrations, botanical artists can combine features from multiple plant specimens, seasons, and magnifications into a single illustration, ensuring all diagnostic characteristics are shown. Unlike photographers, who are limited to what the camera captures, artists use skill and judgment to emphasize important details and control the background composition for clarity (Hickman et al., 2017).

Generative Artificial Intelligence (GenAI) uses deep-learning algorithms to produce new content such as text, images, video, or sound (Kusumawardani et al., 2024). GenAI technology is a recent

development in art and education for producing creative content, including illustrations. The popularity of artificial intelligence has motivated many researchers to investigate its use in producing creative works. Oksanen et al. (2023) reviewed 44 research articles on the use of artificial intelligence in art and highlighted the need for research evaluating whether artificial intelligence can produce better products than humans. The review indicated that transformative artificial intelligence has the potential to be an effective tool for artists and others working in the arts (Oksanen et al., 2023).

This challenge has prompted researchers to analyze the effectiveness of GenAI in assisting with the creation of scientific illustrations. Previous studies indicate that GenAI tools have potential to support the creation of scientific illustrations (Petroff et al., 2024; Noel, 2024; Haider et al., 2025; Sikandar & Bahar, 2024). GenAI-generated illustrations can inspire viewers by explaining complex concepts through imaginative and detailed scenes (Chen, 2023). However, GenAI still has limitations in its ability to produce accurate and detailed scientific works, especially in the medical field (Petroff et al., 2024; Noel, 2024; Haider et al., 2025; Sikandar & Bahar, 2024). Although many previous studies have explored the use of GenAI for image generation and illustration, comparative studies examining how accurately different GenAI platforms can generate scientific illustrations remain limited. This gap motivated the researchers to compare several GenAI platforms in terms of their ability to generate accurate scientific illustrations.

Botanical illustration is the accurate pictorial depiction of plants and plant traits for a scientific purpose (Oxley & Bebbington, 2017). The botanical artist must understand the importance of accurate, detailed illustration for scientific documentation. They must be able to observe and depict anatomical and morphological features of plant specimens precisely and use art to enhance observation, memory, and understanding of plant structures. Additionally, they must be able to interpret botanical forms and create art informed by historical, cultural, and ethnic perspectives (Swann & Pye, 2019). This study examines the accuracy of botanical illustrations generated with GenAI tools to assess their potential and their capacity to accelerate the creation of botanical illustrations.

Although substantial research has examined the use of GenAI in the medical field, its use for scientific illustration in botany remains limited. In botany, AI has demonstrated significant potential in supporting botanical research and plant identification. However, while AI tools offer increased efficiency and accessibility, their accuracy remains limited in distinguishing rare or morphologically similar species (Karakaya, 2024; Scholten, 2025). Further potential may emerge as GenAI technology continues to develop (Petroff et al., 2024; Noel, 2024; Haider et al., 2025; Temsah et al., 2024; Sikandar & Bahar, 2024). This gap motivated the researchers to compare several GenAI platforms in generating scientific illustrations of selected flora. The generated illustrations were evaluated based on predefined criteria to examine their visual quality and the accuracy and completeness of the floral structures. Through this comparison, the study assesses differences in the ability of GenAI platforms to generate scientific illustrations. Furthermore, the comparison aims not only to compare platform performance but also to identify common patterns of accuracy and errors in the generated botanical images. By examining the visual and anatomical aspects of the images, this study seeks to better understand the strengths and limitations of GenAI in generating botanical illustrations.

Method

The method used in this study is a descriptive qualitative research method with a comparative approach to evaluate the visual accuracy of AI-generated botanical illustrations. The comparative approach was used to examine differences in visual aspects and accuracy of illustrations generated by different GenAI platforms. As described by Ramdhan (2021), comparative research involves comparing two or more variables or objects to identify and evaluate differences between them.

In general, GenAI technology uses two prompts to produce images. The two prompts are Text-to-Image and Image-to-Image. This study examined illustrations generated using the Text-to-Image prompt mode, in which text relevant to the intended image was provided to the GenAI tools. The study

evaluated whether GenAI tools could produce botanical illustrations that accurately depict plant morphology and anatomy, as illustrated in Figure 1 (Oxley & Bebbington, 2017).

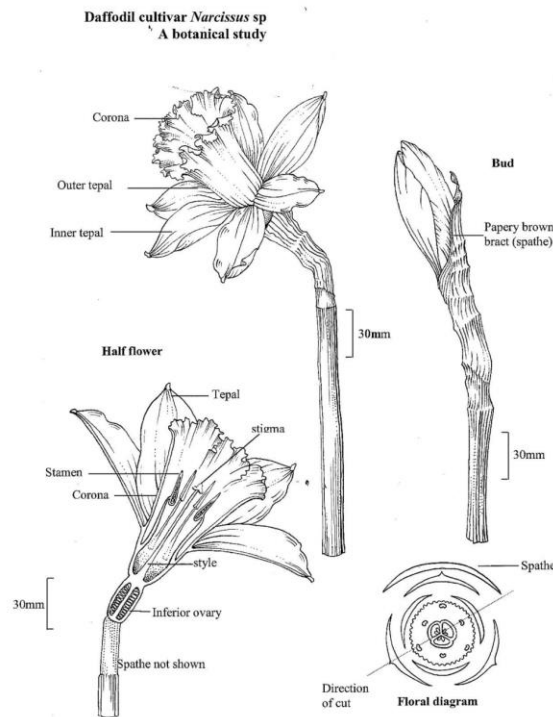


Figure 1 Example of a floral formula (bottom left), floral diagram (bottom right), and half-flower (left) showing the floral structure of daffodil (*Narcissus* species).
(Source: Oxley & Bebbington, 2017)

Previous studies have compared various GenAI tools for image generation (Braguez, 2024). Based on this prior work, the researchers selected four GenAI tools that generate images from text-to-image input, shown in Table 1. To support accessibility and replicability, the researchers chose four GenAI tools that offer free-access accounts. The GenAI platforms were 1) GPT-4 (free version); 2) Stable Diffusion Web (free version); 3) Microsoft Bing Image Creator powered by DALL·E; and 4) Leonardo AI (free version).

Table 1 AI-powered text-to-image generator platforms

GenAI			Source	Prompt
GPT-4 free			https://chatgpt.com/	<i>Text-to-Image</i>
Stable Diffusion			https://stablediffusionweb.com/	<i>Text-to-Image</i>
Microsoft	Bing	Free	https://www.bing.com/images	<i>Text-to-Image</i>
powered by DALL·E				
Leonardo AI			https://app.leonardo.ai/image-generation	<i>Text-to-Image</i>

All the illustrations were generated with the default settings of each GenAI model/tool without modifying or customizing any generation parameters, including the seed and other model-specific settings. Four AI-generated illustrations were produced for each flower type on each GenAI platform. For each flower type, one illustration from each AI tool was selected as a representative sample for further evaluation.

The illustrations were evaluated according to predetermined visual quality criteria related to image clarity and morphological completeness. Image clarity was defined as the sharpness and visibility of botanical details, and morphological completeness was defined as the presence and clear visibility of the main floral forms, without cropping, omission, obstruction, or visible distortion. This study used roses (*Rosaceae*), orchids (*Orchidaceae*), and corpse flowers (*Rafflesia arnoldii*) as case

studies for botanical illustration. The rose is a common, well-known flower. The orchid is a diverse group of plants with many species. The corpse flower is a distinctive, relatively rare plant species with an unusual flower form. The selected cases were intended to represent variation in familiarity, morphological features, and perception.

The representative illustrations generated by each AI tool were selected. The selected GenAI-generated illustrations were visually evaluated and subjected to expert validation in botanical illustration. This approach allowed a more nuanced qualitative assessment of each selected image rather than relying only on numerical accuracy scores. The selected images were then analyzed by an expert in botanical illustration with relevant experience. The validator in this study was a professional botanical artist from the Indonesian Society of Botanical Artists (IDSBA). The expert's affiliation with the Indonesian Society of Botanical Artists was relevant because its members have experience in botanical art and are familiar with observing and drawing plant characteristics accurately. This expertise was pertinent to the study because it supported evaluation of the visual quality, botanical details, anatomical structures, and accuracy of the illustrations produced by GenAI. The expert then compared the generated illustrations with the reference species to assess the degree of correspondence of the main visual and anatomical features with the flower type and illustration style. In the validation protocol, the AI-generated illustrations were presented for expert review to assess the accuracy of each image and identify discrepancies or errors. The experimental workflow is summarized in Figure 2.

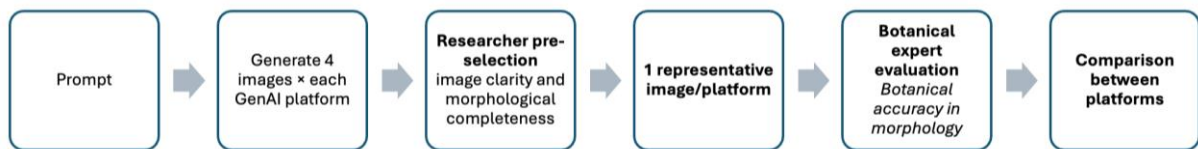


Figure 2 Experimental image-generation process
(Source: Author documentation)

Results and Discussion

To compare the results objectively and in a balanced manner, the researcher used the same prompt language for each GenAI platform. The use of the same prompt was intended to make the image generation process similar across all GenAI platforms and to reduce differences caused by variations in the instructions given to each tool. The researcher used the following prompts to generate the scientific illustrations:

1. Detailed and Accurate Anatomy of Rose
2. Detailed and Accurate Anatomy of orchid
3. Detailed and Accurate Anatomy of Rafflesia Arnoldii

In point 3, the researcher did not use the term "corpse flower" because the word "corpse" was censored by the GenAI tools. After the GenAI tools generated multiple outputs, the illustrations were selected based on image clarity and anatomical completeness. The selected images were then used for further evaluation based on the predefined criteria. This process was used to make the comparison between the four GenAI platforms more consistent and balanced. Figure 3 presents the illustrations generated by the four GenAI platforms.

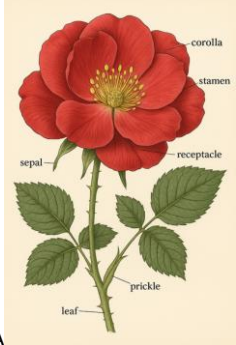
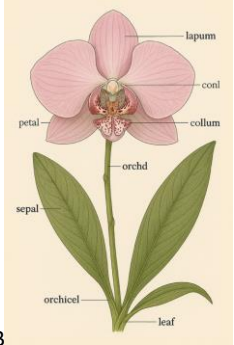
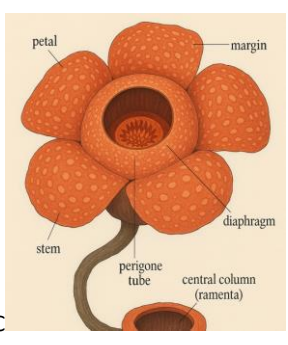
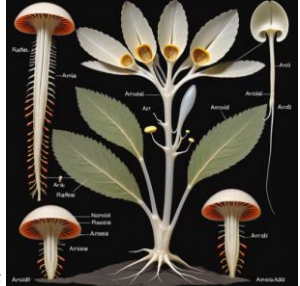
Text-to-Image Generator	Prompt		
	Detailed and Accurate Anatomy of Rose	Detailed and Accurate Anatomy of orchid	Detailed and Accurate Anatomy of Rafflesia Arnoldii
GPT-4 free version			
Stable Diffusion free version			
Microsoft Bing powered by DALL-E free version			
Leonardo AI free version			

Figure 3 Illustrations generated by AI-powered text-to-image generators.
(Source: Images generated by ChatGPT-4 [A–C], Stable Diffusion Web [D–F], Microsoft Bing Free powered by DALL·E [G–I], and Leonardo AI [J–L].)

At first glance, the generated illustration of roses appears more representative of real roses than other flower types. Meanwhile, some of the generated images of *Rafflesia arnoldii* differ from the actual flower form. However, to validate the results, the researcher sought expert validation in botanical illustration as part of the visual evaluation. Expert validation revealed the limitations of each illustration and the suitability of its botanical illustration style for scientific purposes, as depicted in Table 2.

Table 2 Expert validation of each AI-generated illustration

Image Number	GenAI	Flora	Validation Expert
A	GPT-4 free version	Rose/ <i>Rosaceae</i>	<ul style="list-style-type: none"> - The lowest leaf (left side) lacks a stipule. - The right leaf is well rendered. - The arrangement of stamens should form a complete circle, not partially bald. - The labeling of floral organs is incorrect.
B	GPT-4 free version	Orchid/ <i>Orchidaceae</i>	<ul style="list-style-type: none"> - The flower shape is accurate. - The arrangement of the bottom leaves is incorrect; it should be alternate. - Leaf venation is inconsistent with actual structure. - The inflorescence emerges from the wrong position; it should arise from the axils or internodes. - The labelling of organs is inaccurate.
C	GPT-4 free version	corpse flower/ <i>Rafflesia Arnoldii</i>	<ul style="list-style-type: none"> - The shape is appropriate; however, the semicircular section at the bottom appears to be a flower cross section, which is difficult to interpret. - The labelling of organs is mostly incorrect (except for "diaphragm" and "perigone tube").
D	Stable Diffusion free version	Rose/ <i>Rosaceae</i>	<ul style="list-style-type: none"> - The image does not convey any useful botanical information. - Leaf shape is inaccurate. - The text is unreadable. - The magnified section provides no additional anatomical information.
E	Stable Diffusion free version	Orchid/ <i>Orchidaceae</i>	<ul style="list-style-type: none"> - The image resembles botanical photography or botanical art rather than scientific illustration. - The overall form is accurate, except for one oddly positioned bud with an unnatural protrusion.
F	Stable Diffusion free version	corpse flower/ <i>Rafflesia Arnoldii</i>	<ul style="list-style-type: none"> - The illustration does not clearly represent any identifiable species.
G	Microsoft Bing powered by DALL-E free version	Rose/ <i>Rosaceae</i>	<ul style="list-style-type: none"> - These are more artistic botanical illustration and cannot be used as scientific botanical illustrations.
H	Microsoft Bing powered by DALL-E free version	Orchid/ <i>Orchidaceae</i>	<ul style="list-style-type: none"> - These are more artistic botanical illustration and cannot be used as scientific botanical illustrations.
I	Microsoft Bing powered by DALL-E free version	corpse flower/ <i>Rafflesia Arnoldii</i>	<ul style="list-style-type: none"> - The form is too abstract to be interpreted botanically.
J	Leonardo AI free version	Rose/ <i>Rosaceae</i>	<ul style="list-style-type: none"> - The anatomical details are inaccurate. - The text is illegible and difficult to interpret. - The enlarged or separately drawn organs are not relevant, except for the top view (dorsal view) of the rose bud, which depicts a layered hybrid rose.

K	Leonardo AI free version	Orchid	<ul style="list-style-type: none">- The overall illustration is acceptable; however, the depicted flowers lack consistency.- The dissection is inaccurate and does not provide additional anatomical information.- Two flower buds located at the middle-right are anatomically incorrect.- The accompanying text is unreadable and incomprehensible.
L	Leonardo AI free version	corpse flower	<ul style="list-style-type: none">- The form is abstract and lacks botanical clarity.

Floral Diversity and Fidelity of GenAI Botanical Illustrations

The results indicate that AI still has limited ability to generate accurate and detailed botanical illustrations. In this research, the selected plant types showed differences in the accuracy and detail of the generated illustrations. In Figure 3, which depicts the image of a rose (A, D, G, and J), there is a similarity in the shape of the coronas, tepals, leaves, and stems compared to a real rose; however, expert evaluation still identified inaccuracies. According to the expert evaluation, although the rose illustration bears a superficial resemblance to actual roses, the details of the leaves and the arrangement of some floral organs are incorrect. Moreover, in the illustration generated by ChatGPT-4, the labels for the plant's morphological structures are inaccurate. Meanwhile, in the image of the corpse flower, only image C generated by ChatGPT-4 showed some similarity to the corpse flower; images F, I, and L are too abstract to be interpreted botanically, lack clarity, do not represent any identifiable species, and cannot be called scientific illustrations of the corpse flower. Regarding the depiction of orchids, the results indicate similarities to orchids, particularly in images B, E, H, and K shown in Figure 3. However, expert evaluation indicated that some leaf arrangements are incorrect, and certain parts of the floral organ are positioned incorrectly or oddly. This finding is consistent with research on AI limitations in accurately identifying rare or morphologically similar plant species (Karakaya, 2024; Scholten, 2025). One common theme was the disparity between visual plausibility and scientific accuracy. Several generated illustrations seemed visually plausible or aesthetically comparable to botanical illustrations, but expert evaluation revealed anatomical mistakes, missing structural information, or incorrect labeling. Thus, visual similarity does not ensure that the image is suitable for scientific botanical illustration.

Overall, the results indicate that the form of the flowers varied across the four GenAI platforms. These results are in line with the work of Li and Wang (2026), who showed that different GenAI platforms can produce different visual representations and levels of scientific accuracy for images of flora and fauna. Similarly, the current study showed differences in the representation of morphological features of roses, orchids, and corpse flowers in ChatGPT-4, Stable Diffusion, Microsoft Bing, and Leonardo AI. Across all three selected plant types, the illustrations generated by ChatGPT-4 were generally recognizable and close to the actual appearance, with some anatomical details still incorrect. Stable Diffusion results were less consistent, and some of the illustrations resembled botanical art rather than scientific illustrations. The *Rafflesia* illustrations were particularly difficult to identify. Microsoft Bing generated more artistic, abstract images, making them less appropriate for scientific botanical illustration. Leonardo AI produced a recognizable rose and orchid drawing, but some anatomical features were still inaccurate. The *Rafflesia* image produced by Leonardo AI was also too abstract and lacked clear botanical details.

Anatomical inaccuracies were recurrent across the evaluated generated illustrations, especially in terms of leaf arrangement, venation patterns, floral structures, organ positioning, and anatomical labeling. However, closer expert evaluation showed that although some generated images had plausible overall forms, inconsistencies remained in the details of the botanical structures.

Anatomical Distortion and the Imaginative Aesthetic in GenAI Biomimicry

Previous research on AI-enabled biomimicry in art has described anatomical distortion, in which generated images differ from real biological structures. These distortions, called mimiphenia, reveal the creative process between imitation and transformation. AI can reinterpret life forms by balancing accuracy and abstraction, but this process may result in anatomical distortions (Melanitis, 2025). Consistent with previous studies, the findings of this research show anatomical distortions associated with the GenAI generation process. GenAI simulates and combines organic patterns, forms, or behaviors found within its resources. The result can be a semi-realistic, dreamlike, or anatomically distorted representation that reveals both the potential and limits of artificial mimicry. In general, the generated botanical illustrations were able to capture the overall appearance of the flowers, but some outputs deviated in specific morphological features; for example, the generated representations of *Rafflesia* were highly abstract and showed significant deviations from their characteristic morphological features, making the flowers difficult to identify based on their generated form alone. These deviations show that the GenAI models not only reproduced the botanical structures but also altered some features during the generation process. Thus, consistent with Melanitis (2025), our findings suggest that the creative transformation during GenAI generation could have led to deviations between generated illustrations and real flower morphology.

Based on the research, illustrations generated by all four GenAI platforms showed anatomical distortion, but the types of errors were different. ChatGPT-4 displayed a number of inaccurate anatomical features, including leaf arrangement, leaf venation, and stamen arrangement. The primary forms of the selected plants were recognizable. Stable Diffusion outputs showed poor anatomical accuracy, such as an incorrect leaf shape in the rose image, an oddly positioned bud with an unnatural protrusion in the orchid, and an unclear representation of *Rafflesia*. Microsoft Bing generated more artistic and abstract images that made it difficult to interpret the anatomical structures, especially in the *Rafflesia* image. Leonardo AI also revealed some anatomical errors in the rose and orchid images, especially in the floral structures and dissection. The Leonardo AI *Rafflesia* image was too abstract, and it did not show any clear anatomical details. Images F, H, I, and L illustrate the imaginative aesthetics of GenAI biomimicry. The generated images were more imaginative and abstract, with some floral structures appearing almost alien-like, making the anatomical structures difficult to identify.

The Future of GenAI in Botanical Illustration

The results indicate that the accuracy of images produced by current GenAI tools is not yet adequate for scientific botanical illustration. However, ChatGPT-4 and Leonardo AI generated visuals that more closely resembled botanical illustration styles. ChatGPT-4 used a simpler illustration style, making it easier to identify important botanical features such as coronas, tepals, leaves, and stems, which may help viewers identify key botanical information more readily. These two GenAI tools, ChatGPT-4 and Leonardo AI, generated detailed, semi-realistic images that could attract readers' attention, but their illustration styles were not suitable for scientific botanical illustration. Stable Diffusion images contained less useful botanical information, and some of the results looked like botanical art or photography rather than scientific illustrations. Microsoft Bing also produced images that were more artistic in style and therefore less appropriate as scientific botanical illustrations. Further research is needed to identify suitable GenAI-generated illustration styles for botanical use. A balanced integration of detail, scientific accuracy, and visual clarity is essential to ensure that the resulting image qualifies as a reliable scientific illustration.

There were also some problems with the labels and text in illustrations generated by the different platforms. ChatGPT-4 mislabeled some floral organs, especially in the illustration of *Rafflesia*. The output of Stable Diffusion was unreadable, and there was no meaningful information. The text generated by Leonardo AI in the rose and orchid images was also difficult to read and understand. Microsoft Bing mainly produced artistic and abstract images, resulting in limited labeling and scientific information.

GenAI-generated illustrations can provide inspiration and help users explore different visual styles in botanical illustrations. GenAI platforms can quickly produce various forms, compositions, and illustration styles and can serve as useful initial references. The potential of GenAI as an exploratory reference for visual communication has been demonstrated in botanical and ecological visualization through the varied styles and features of different GenAI tools (Li & Wang, 2026). The expert evaluation indicates that GenAI can provide interesting visual references and alternative approaches to botanical illustration, but issues with anatomical accuracy, floral structures, labeling, and representation of some plant forms persisted. Therefore, GenAI outputs are more suitable as a source of inspiration than as a direct basis for producing scientific illustrations, as the accuracy of plant forms and structures still needs to be checked and adjusted based on real specimens and expert knowledge.

The expert evaluation also showed that the generated illustrations should be checked and corrected based on real specimens and botanical knowledge. GenAI still cannot replace human-made botanical illustrations that require careful observation, knowledge of plant anatomy and morphology, purposeful composition, and the selection of important plant features. This is consistent with previous studies showing that AI-generated botanical images may have errors in species identification and morphological feature analysis and thus emphasize the need for expert validation and comparison with established botanical references (Peregrym et al., 2026). Hence, GenAI is more appropriate today as an assistive tool for exploring inspiration and illustration styles rather than as a replacement for human botanical illustrators.

Conclusion

The research findings suggest that AI has potential in botanical illustration, especially for inspiration to explore different styles of botanical illustration. However, current artificial intelligence technologies are not yet able to create fully accurate scientific representations. Overall, ChatGPT-4 generated identifiable botanical illustrations. The floral forms are reasonably clear, although some are anatomically incorrect. Thus, its accuracy was relatively higher but still needed validation by an expert. Stable Diffusion created less stable botanical illustrations, some of which resembled botanical art more than scientific illustrations and showed lower botanical accuracy. Microsoft Bing generated more artistic and abstract botanical illustrations, with limited anatomical information, making the illustrations less suitable for scientific botanical illustration. Leonardo AI generated recognizable rose and orchid illustrations, but the *Rafflesia* image was highly abstract, resulting in mixed accuracy across the selected plants. However, *Rafflesia* showed a similar problem across all four GenAI platforms, as none of the generated illustrations closely represented its actual floral form. This study indicates that the generation of less commonly depicted plant species may pose more significant challenges for GenAI models. Nevertheless, this study does not analyze the structure or availability of training data; hence, the impact of training data availability should be viewed as a plausible explanation rather than a confirmed cause. Additionally, selecting an appropriate illustration style is crucial to effectively convey scientific details. GenAI may be used to inspire exploration of different styles and compositions within the framework of botanical illustration and is currently more suitable as a supporting tool than a replacement for human-made botanical illustrations. Future studies may yield different results, given the rapid development of GenAI. Several limitations should be considered when interpreting the findings. Three botanical specimens, namely rose, orchid, and *Rafflesia arnoldii*, were examined, and one representative output from each GenAI platform for each of the three selected flower types was evaluated rather than all generated outputs. Expert validation was limited to one botanical specialist. Thus, the findings should be interpreted in the context of the specific cases and selected outputs and should not be generalized to all botanical species or GenAI platforms.

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