

EXPLORING A.I. IN DESIGN EDUCATION

ENHANCING IDEATION WITH A.I. TEXT-TO-IMAGE GENERATORS IN DIGITAL DESIGN COURSES

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The rapid emergence of A.I.-powered applications is transforming most industries, including design. This paper investigates the integration of A.I. text-to-image generators—programs that use A.I. to create new images—in design education to better understand their potential and limitations. As a curricular innovation in an introductory course in digital design, the author introduced Midjourney—an A.I. image generator—to expand the ideation process students follow in a design project. Two cohorts of 100 undergraduate students in Industrial, Interior, and Apparel Design experienced using this tool as part of their workflow in one project. Results showed that A.I. image generators improved students' visualization capabilities, facilitated unexpected creative outputs, and promoted equity and inclusion within the classroom. Additionally, A.I. image generators enhanced student collaboration and communication, fostering a dynamic learning environment. As A.I. continues to influence design practice and design education, the author argues that it is essential for educators to remain informed, explore with their students the possibilities, limitations, and ethical considerations of A.I. tools, and, ultimately, contribute to shaping the responsible and innovative use of A.I. in the future of design practice.

Keywords: Artificial Intelligence, Text-to-Image Generation, Design Education, Ideation, Digital Design.

1. INTRODUCTION

Throughout the second half of 2022 and the first half of 2023, the world saw an unprecedented surge of new platforms, services, and technologies powered by Artificial Intelligence. Since April 2022, multiple A.I. models to generate images, text, video, and audio have been made public, and hundreds of applications to implement these models have been released at a breakneck pace; for instance, ChatGPT, one of these A.I.-powered tools, is considered the fastest-growing consumer application in history by reaching 100 million users in only two months after its public release (Hu, 2023). Additionally, these models and applications have attracted not just millions of users, but also the attention of most media outlets, generating numerous headlines, magazine covers, and social media content (Heaven, 2023).

As the pace of development continues to accelerate, adopting these technologies has sparked conversations and reflections about their impact on every aspect of human life. In the Design field, there have been conversations about how A.I.-powered tools will reshape the design process, the skills that future designers will need to master to use A.I. as part of their workflow, and the potential implications for the job market in creative professions. Even though it is impossible to predict the impact of A.I. in

the future of design practice and education, it is undeniable that these technologies will play an important role and will become part of the toolbox of creative professionals in the coming years (Roose, 2022).

Motivated by the rapid evolution of A.I. tools and the certainty that future design practitioners will interact with these technologies daily, the author started to explore the use of A.I. image generators in design education to understand their potential and limitations better. Beginning in the fall of 2022, the author integrated Midjourney (www.midjourney.com) into an introductory digital design course for undergraduate students in Industrial, Interior, and Apparel Design as a curricular innovation. This tool was implemented in the ideation phase of the design process, where the author hypothesized that A.I. image generators could have a profound impact on the students' creative process. At the time of writing this paper, two cohorts of students had experienced the use of Midjourney in their creative workflow, providing valuable insights into the effectiveness and potential challenges of using Artificial Intelligence in design education.

The experiences the author had introducing Midjourney in this course and the results that students had in their projects as a result of the use of this tool are presented and discussed in this paper. Ultimately, this article intends to contribute to the ongoing conversation about the role of A.I. in design education and its implications for the future of the field.

2. A.I. TEXT-TO-IMAGE GENERATORS

A.I. text-to-image generators, such as Midjourney, DALL-E, Stable Diffusion, or Adobe Firefly, are software tools that produce images based on text descriptions provided by users. The software's internal mechanisms use advanced artificial intelligence techniques to generate images that closely match the given description. These tools have two main components to generate new images: one neural network that associates images with text and another that generates images from scratch. The underlying process for generating images involves diffusion models, which are neural networks trained to remove pixelated noise from images, gradually refining the output from a mess of pixels to a high-resolution picture as seen in Figure 1 (Heaven, 2023; Ploennigs & Berger, 2022).

The technology behind A.I. text-to-image generators has evolved rapidly in recent years. In the past, creating A.I.-generated images required gathering specific datasets of images and training models to mimic them. This approach was limited, as models trained on one type of image (e.g., portraits) could not create other types of images (e.g., landscapes). However, advancements in A.I. now allow for massive models that can generate a wide variety of images based on simple text input. This is made possible through large, diverse training datasets consisting of billions of images scraped from the internet, accompanied by their text descriptions.

A.I. image generators create images by navigating through a mathematical space called “latent space.” This space has thousands of dimensions and represents variables the deep learning models identify as they process the training data. Each point within this space can be considered a recipe for a potential image, and the text prompt helps navigate to a specific location in the space. The process of translating a point in latent space into an actual image involves diffusion, which starts with noise and, through a series of iterations, arranges pixels into a composition that makes sense to humans (Vox, 2022).

The ability of deep learning to extract patterns from massive volumes of data is opening deep and unresolved questions about the social, legal, cultural, and political implications of using these models. For instance, it is possible to generate images that replicate an artist’s style without copying their artwork, which opens debates regarding copyright and intellectual property of these images. Also, as A.I. image generators evolve, the images are becoming increasingly realistic, which can be exploited by bad actors to produce disinformation campaigns. Additionally, these models contain disturbing associations learned from the internet, reflected in images that depict biases regarding gender, race, ethnicity, and cultural background, among others (Bridle, 2023; Chatterjee, 2022; Chow & Perrigo, 2022).



Figure 1. Image generation process using the prompt “espresso machine” in Midjourney. This process starts with visual noise which is gradually refined to obtain a high-resolution image (Source: Author). A video of this process can be seen at <https://youtube.com/shorts/yWcnNTWdVTQ>

3. USING A.I. FOR DESIGN IDEATION

As mentioned in the Introduction, the focus of this study was the use of Artificial Intelligence to enhance and expand the ideation phase of the design process that students follow in an introductory course to digital design. The author hypothesized that A.I. image generators could have a profound impact on the students' creative process since these tools reduce the time and effort required to visually represent ideas, expand the possibilities imagined by students by creating unexpected variations of the textual prompt, and allow users to combine multiple concepts into a single image seamlessly.

Additionally, these tools may help design students overcome creative blocks during the design process by providing new visual perspectives that they may not have considered otherwise, providing inspiration, sparking new ideas, and leading to innovative and creative design solutions. In the case of novice students who do not have strong drawing skills or who come from underserved communities that do not have access to art and design education, these tools may help them to visualize their ideas with a similar proficiency to their more privileged peers, promoting equity and inclusion in the classroom.

Furthermore, A.I. image generators can help students explore complex or abstract ideas that are often difficult to convey visually through traditional methods. These tools allow students to experiment with and explore more sophisticated and intricate concepts that they may have otherwise avoided due to the challenges of visually representing them. This can lead to new insights and ideas that may not have been discovered without the assistance of A.I. technology, allowing students to push the boundaries of their creativity and expand their design skills.

These hypotheses are consistent with the scarce literature available on the use of Artificial Intelligence in design education and in the design field. For instance, Ploennigs & Berger argue that A.I. image generators are a valuable resource for generating concepts in any field that involves creative visual design work, including the initial phases of architectural design that involve various steps of ideation, sketching, and modeling (2022). This idea is supported by Seymour, who states that "A.I. tools are providing a new way to explore ideas... [making them an] incredibly rich source of ideation and inspiration in ways yet to be discovered" (2022, p. 23).

In a study on students' perceptions of the use of A.I. image generators in the context of digital literacy education, Dixon reported that students identified that these tools "could be used to test creative ideas, expand techniques, and help realize artists' imagination" (2023, p. 22). In the professional practice, Sloane interviewed numerous artists, designers, and creators, who highlight the value of these tools for creating unprecedented combinations of brands and concepts and who perceive A.I. image generators as a "sparring partner for when you're creating" (2023).

In another study, Jaruga-Rozdolska (2022) explored the use of A.I. tools to support creative practices in architecture. The study found that Midjourney could generate aesthetically pleasing digital images of

buildings based on selected architects and given prompts. Furthermore, the speed of creation was significantly faster than any previously released software, providing a distinct advantage during the ideation process. However, the author noted that these technologies, in their current state, are effective for concept generation but are inadequate to create a complete and cohesive architectural design.

In conclusion, the literature supports the notion that Artificial Intelligence has a promising potential to enhance and expand the ideation phase of the design process. The use of A.I. image generators can reduce the time and effort required to represent ideas visually, expand the possibilities imagined by students, and aid in the visualization of complex ideas. Moreover, these tools can spark new ideas and facilitate collaboration among design students, leading to the creation of novel and unique design solutions. While these technologies are currently better suited for concept generation rather than creating complete designs, the use of A.I. in the ideation process shows great promise, for which the author planned and implemented the curricular innovation described in the following sections.

4. CONTEXT AND PARTICIPANTS

The curricular innovation discussed in the following section was introduced at a public teaching university located in the Southeastern region of the United States. This academic institution offers undergraduate programs in Industrial Design, Interior Design, and Apparel Design. The curricular innovation was incorporated into an introductory course in digital design, which is a mandatory requirement for all first-year students enrolled in the aforementioned programs.

Approximately 220 students enroll in this course each academic year, which is offered across 11 sections during the Fall, Summer, and Spring semesters. The course's primary objective is to introduce students to the fundamentals of digital design through industry-standard software such as Adobe InDesign, Photoshop, and Illustrator. The course curriculum is designed to provide students with a strong foundation in digital illustration and presentation techniques, which will be crucial to their success in their respective design disciplines.

Throughout the course, students engage in various projects and assignments that aim to develop their digital design skills progressively. These practical exercises are tailored to encourage creativity, digital literacy, and problem-solving abilities, which are essential attributes for any aspiring designer. The acquired skills and knowledge from this introductory course are then applied and further developed in the students' subsequent studio-based and design-specific classes.

5. A.I. IMPLEMENTATION

In the digital design course described before, students work on several short assignments to learn specific tools and techniques in Photoshop, Illustrator, and InDesign. In parallel, they work on longer projects where they apply and combine the skills and knowledge acquired in the shorter assignments.

One of the long projects involves designing a shoe based on students' preferences and interests and rendering it in Illustrator and Photoshop. The author selected this project to introduce Midjourney, considering the length and open-ended nature of the project and the potential for experimenting with form, color, texture, and materials when designing footwear.

The project began with a workshop introducing Midjourney, as part of the design process. The workshop covered various aspects of Midjourney, including its purpose, functionality, and potential applications in the design field. Participants were guided through the process of getting started with Midjourney and learned how to create images, craft effective prompts, and control the output using various parameters. The workshop also provided a list of recommended resources for further exploration. The workshop's key focus was crafting effective prompts for optimal results. Students were presented with several strategies, such as being clear and specific, defining the visual style, technique, and materials, creating unexpected combinations, and experimenting with iterations. These strategies aimed to enhance the students' ability to harness the full potential of Midjourney and successfully incorporate A.I. image generation into their design process.

After the workshop, students brainstormed ideas and were encouraged to explore various shoe concepts, combining different styles or drawing inspiration from their favorite movies or characters. Then, they were asked to create prompts for Midjourney, using descriptive words that captured their shoe concept. This process resulted in three distinct shoe concepts, with two views (side and sole) for each, totaling six images generated using Midjourney. Next, students were required to create hand-drawn sketches based on their Midjourney-generated concepts. The instructor approved these sketches before students proceeded to the next step, which consisted in importing their sketches into Adobe Illustrator to create outlines of their chosen shoe design.

As students progressed, they refined their design by adding details such as stitching, colors, patterns, and textures to give their shoe dimension and realism. Finally, they created a poster presentation in Illustrator to showcase their Midjourney images, sketch, outlines file, and completed shoe design. Additionally, a few weeks after students completed their work in Illustrator, they revisited this project to render a new version of the shoe in Photoshop, using the tools and techniques provided by this software. In this part of the assignment, they were required to incorporate realistic patterns, textures, reflections, shadows, and gradient backgrounds to enhance the design and create a realistic render. In previous years, students completed this assignment without the assistance of Midjourney for the ideation phase but followed the same process to create their shoe concepts and their renders using Illustrator and Photoshop. A visual representation of the process can be seen in Figure 2.



Figure 2. Synthesis of the process followed by students: (1) inspiration images generated in Midjourney; (2) hand-drawn sketches based on inspiration images; (3) outlines of shoe design created in Illustrator; (4) completed shoe design rendered in Photoshop.

6. RESULTS

The results of this study offer valuable insights into the integration of A.I. text-to-image generators in design education. This section explores the impact of utilizing these tools on students' creative processes, as previously discussed, while also addressing the risks and challenges associated with these emerging technologies within design education.

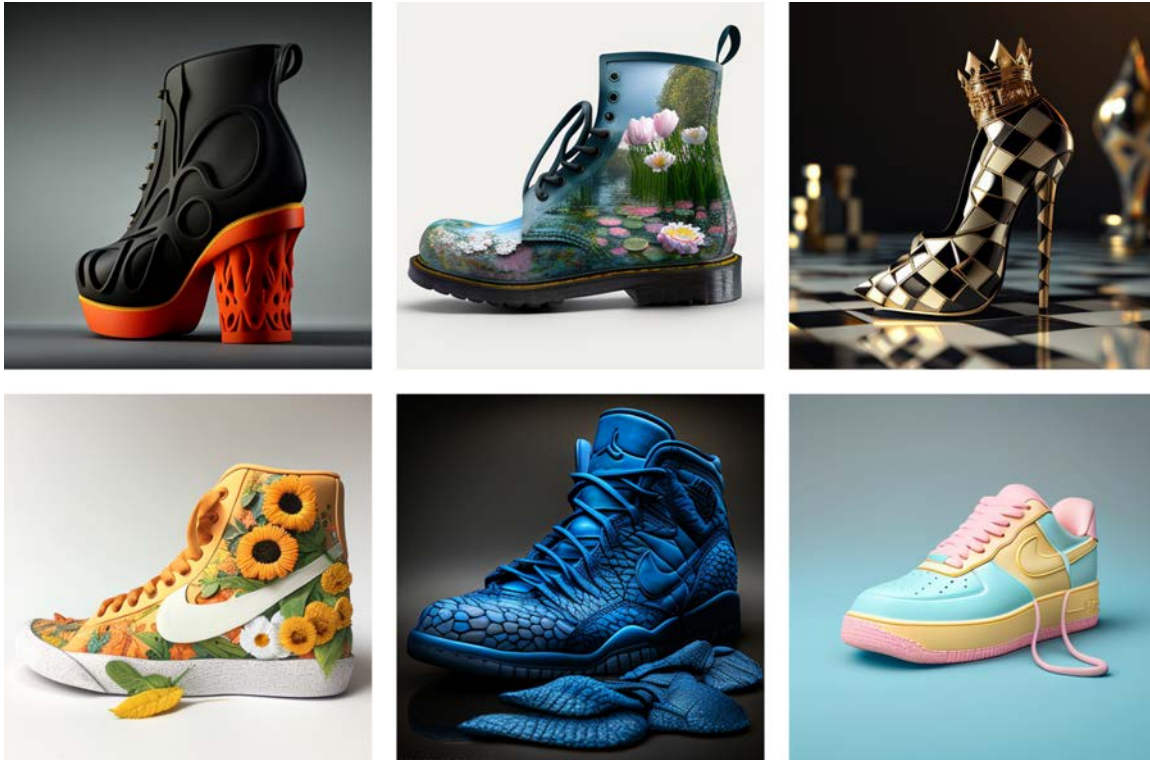


Figure 3: Examples of shoe concepts generated in Midjourney by the students (Source: Author).

6.1. IMPACT ON STUDENTS' CREATIVE PROCESS

Reducing the time and effort needed to visualize ideas: The integration of A.I. image generators into the curriculum demonstrated that these tools can significantly reduce the time and effort needed to visualize ideas. By using Midjourney, students were able to generate multiple concept sketches within minutes, allowing them to refine their ideas faster than with traditional sketching methods. For example, a student working on their shoe project, used Midjourney to explore various material combinations, colors, and textures in minutes, resulting in faster ideation and iterations. Students also reported feeling less pressure to produce a "perfect" sketch, as they could use Midjourney as a starting point to refine and develop their ideas further. Moreover, students saved time and effort by using Midjourney for repetitive tasks such as creating patterns and textures. For instance, one student mentioned that using Midjourney allowed them to create several options for the shoe's sole texture, which would have taken them significantly longer to achieve through manual drawing. By using A.I. image generators, students could focus more on refining their design concepts and exploring different options, ultimately leading to more innovative and creative design solutions.

Creating unexpected variations from textual prompts: The use of Midjourney enabled students to explore unexpected variations of their ideas by adding more randomness to the outputs generated by the A.I. tool through the parameter --stylize. For instance, a student working on their shoe project

identified color schemes they had not considered before by allowing Midjourney to apply random color combinations to the generated footwear images. Likewise, another student identified new texture possibilities that are not usually applied to shoes, such as stained glass. This process allowed them to refine their concept and create a more innovative design. Furthermore, the ability to rapidly generate unexpected outputs from textual prompts allowed students to become more open to unexpected results and, simultaneously, become more critical of the outputs generated by the A.I. tool. The unexpected variations produced by Midjourney acted as a source of inspiration, expanding the students' creative processes and allowing them to consider new possibilities. This also led to more fruitful conversations among students, as they shared the unexpected outputs generated by Midjourney and how they might apply them to their designs.

Exploring complex and abstract ideas: Midjourney enabled students to explore complex and abstract ideas that are often challenging to represent visually through traditional methods. For example, one student used Midjourney to create a design that embodied the concepts of love and attachment in a boot. Another student explored the intersection of music and footwear by generating shoe designs inspired by different music genres. Additionally, a student used Midjourney to incorporate patterns and textures commonly found in their cultural clothing and accessories into their shoe design, allowing them to explore how they could represent their cultural identity through footwear. By fostering creativity and encouraging students to think outside the box, Midjourney enhanced their ability to generate innovative design ideas. Moreover, Midjourney provided a new approach to design ideation by allowing students to experiment with abstract concepts in concrete terms.

Overcoming creative blocks: Midjourney proved an effective tool for students who experienced creative blocks or struggled with ideation. Midjourney inspired students to explore new directions in their projects by generating new and unexpected outputs. For example, a student struggling with coming up with a concept for their shoe design project used Midjourney to generate a variety of shoe styles. One generated image, in particular, sparked an idea for a shoe intended for a popular movie superhero. This creative breakthrough allowed the student to develop a unique and innovative design that they may not have thought of without the assistance of Midjourney. Additionally, Midjourney provided students with a new way to approach design ideation by allowing them to experiment with abstract concepts in concrete terms, which was particularly beneficial for those who struggled with visualizing their ideas. Overall, Midjourney helped students overcome creative blocks and generate new ideas, fostering a more creative and engaging learning experience that contributed to their overall growth as designers.

Promoting a more equitable learning experience: Integrating Midjourney into the digital design course promoted a more equitable learning experience, as all students had access to an advanced visualization tool, regardless of their prior software or drawing experience and skill. This helped to level the playing field and enabled individuals from diverse backgrounds to engage in the design process more effectively. For example, students who lacked traditional art and design education or had limited access to design

software at home were able to produce high-quality outputs and refine their design ideas using Midjourney. In contrast, some students with prior experience in design software found Midjourney to be a helpful tool for generating unexpected ideas and exploring new design directions, thereby creating an even playing field for all students.

6.2. RISKS AND CHALLENGES OF A.I. IMAGE GENERATORS

Ethical implications and considerations: The integration of Midjourney in the course required raising students' awareness of the ethical implications of using A.I. image generators in their design work and society as a whole. These implications encompass concerns about implicit biases, intellectual property, and potential misuse. It was crucial to highlight how the vast datasets used to train these tools can contain biases that manifest in generated images perpetuating stereotypes and social inequalities based on race, gender, age, and other factors. The issue of copyright and intellectual property was also addressed by presenting A.I.-generated images resembling the style of artists whose work had been used to train these tools without their consent. Moreover, students were made aware of potential misuse of A.I. image generators, including the dissemination of disinformation or misleading content. They discussed the impact of notable A.I.-generated images that circulated on the web in 2023, such as depictions of Pope Francis wearing a puffer coat (Richardson, 2023) or Donald Trump being apprehended by the police (Devlin & Cheetham, 2023). Through these discussions, the aim was to instill ethical considerations and guide students in the responsible usage of A.I. image generators, fostering ethical practices and equipping them to navigate the ever-evolving landscape of A.I. in design and society.

Technology dependence: The use of A.I. image generators such as Midjourney, while innovative and efficient, can be a double-edged sword in the context of design education, as observed in this study. Even though students were asked to use A.I.-generated images as a source of inspiration for their manual sketches, many of them created shoes that looked very similar to one of the images they obtained in Midjourney. Students were fascinated by some of the images generated digitally, which, in some cases, limited their creativity and capacity to develop new design concepts by themselves. Interestingly, since Midjourney struggled to generate good images of soles—a limitation probably caused by the lack of enough sole pictures in the training dataset, students pushed themselves to create interesting soles consistent with the shoes' side view. While A.I. image generators offer fascinating possibilities, it is crucial to navigating their use discerningly, ensuring they complement rather than compromise students' development as well-rounded, competent designers.

Proficiency and learning curve: Harnessing the full potential of A.I. image generators posed a significant challenge to novice designers, as observed in the study. Incorporating Midjourney into the course required additional time, support, and practice for students to use this tool proficiently. The ability to produce accurate and desired outputs using Midjourney heavily relied on the clarity and specificity of

the input prompts, which posed a unique challenge for students in articulating their ideas effectively, concisely, and aligned with the language understanding of Midjourney. This issue was addressed by giving students a basic prompt structure and several examples of prompts that they were invited to use, tweak, and improve based on their design intentions. Additionally, students were invited to be persistent and patient as they were becoming more adept at crafting effective prompts. As a consequence, the introduction of Midjourney served as an opportunity for students to not only explore new design tools but also refine their verbal articulation of visual concepts, an invaluable skill in today's collaborative and interdisciplinary design practice.

7. CONCLUSIONS

The rapid advancement of Artificial Intelligence in various fields indicates that its impact on design seems inevitable. For instance, prominent design firms are already incorporating A.I. into their creative processes, making it essential for design students to become familiar with these tools under the guidance of design educators. To explore the use of A.I. image generators in the context of design education, the author explored their implementation to support the ideation phase of the design process in a digital design course.

Through the integration of Midjourney in the course, students were able to visualize ideas more quickly, explore unexpected outputs, and expand their creative process, ultimately leading to more innovative and creative design solutions. In addition, A.I. image generators proved particularly beneficial for students struggling with visualization and those from underserved backgrounds, promoting equity and inclusion within the classroom. The use of A.I. image generators also facilitated collaboration and communication among students. By sharing and discussing their prompts and designs, students were able to engage in a more interactive and dynamic learning environment, generate unexpected outputs that inspire new ideas, and expand their creative process.

However, it was evidenced that students must recognize the possibilities, biases, and limitations of A.I.-powered tools. The use of these tools should be framed as a means to strengthen, expand, and shorten the design process while ensuring students remain aware of the ethical and social implications associated with AI. Issues surrounding intellectual property and the ethical use of A.I.-generated images must be considered as design educators introduce these technologies to the next generation of designers. Furthermore, addressing potential biases within A.I. models is vital to ensure that design education remains inclusive and culturally sensitive.

As Artificial Intelligence continues to evolve and become increasingly integrated into the design field, it is crucial for educators to remain informed, adapt their teaching methods and practices to these new technologies, explore with their students the possibilities, limitations, and ethical considerations of these tools, and, ultimately, contribute shaping the responsible and innovative use of A.I. in the future of design practice.

8. REFERENCES

- Bridle, J. (2023, March 24). The stupidity of AI; Artificial intelligence in its current form is based on the wholesale appropriation of existing culture, and the notion that it is actually intelligent could be actively dangerous. *The Guardian*.
- Chatterjee, A. (2022). Art in an age of artificial intelligence. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.1024449>
- Chow, A. R., & Perrigo, B. (2023). The A.I. Arms Race is Changing Everything. *TIME Magazine*.
- Devlin, K., & Cheetham, J. (2023, March 24). Fake Trump arrest photos: How to spot an A.I.-generated image. *BBC News*. <https://www.bbc.com/news/world-us-canada-65069316>
- Dixon, N. (2023). Teaching Digital Literacy in The Context of A.I. Text-to-Art Generators. *Computers in Libraries*, 43(1), 19–22.
- Heaven, W. D. (2023). The Year Creativity Exploded. *MIT Technology Review*, 126(1), 40-47
- Hu, K. (2023). ChatGPT sets record for fastest-growing user base - analyst note. Retrieved on April 1, 2023 from *Reuters.com*: <https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01>
- Jaruga-Rozdolska, A. (2022). Artificial intelligence as part of future practices in the architect's work: MidJourney generative tool as part of a process of creating an architectural form. *Architectus*, 71(1), 95-104. <http://10.0.145.70/arc220310>
- Ploennigs, J., & Berger, M. (2022). A.I. Art in Architecture. Retrieved on March 28, 2023 from *arXiv.org*: <http://arxiv.org/abs/2212.09399>
- Richardson, C. (2023, March 31). The Pope Francis puffer coat was fake – here's a history of real papal fashion. *The Conversation*. <https://theconversation.com/the-pope-francis-puffer-coat-was-fake-heres-a-history-of-real-papal-fashion-202873>
- Roose, K. (2022, October 22). Artificial Intelligence Already Has a Place in the Toolbox of Creative Professionals. *The New York Times*.
- Seymour, M. (2022). As tool of the artist, A.I. helps humans produce valid art. *The Sydney Morning Herald*.
- Sloane, G. (2023). How ChatGPT, DALL-E and Midjourney are fueling unusual brand mashups: Creators are obsessed with using A.I. image generators to design the wildest brand combos. *Advertising Age*, 94(3), 1.
- [Vox]. (2022, June 1). The text-to-image revolution, explained [Video]. YouTube. <https://youtu.be/SVcsDDABeKM>