ENHANCING INDUSTRIAL DESIGN EDUCATION: THE IMPACT OF GENERATIVE AI TOOLS ON MASTERING CREATIVITY TECHNIQUES

Maria Isabel RODRIGUEZ-FERRADAS, Tatiane BALLERINI-FERNANDES and Paz MORER-CAMO
TECNUN - Universidad de Navarra, Spain

ABSTRACT
This study explores the integration of Generative AI tools in design education, specifically focusing on their impact on mastering creativity techniques. Through a series of structured activities and practical sessions, students were introduced to various GenAI tools and their applications in creative processes. The research aimed to assess changes in students' perceptions, confidence, and willingness to incorporate these tools into their creative workflows. Data was collected through surveys, revealing a significant positive shift in students' attitudes towards GenAI. The findings indicate that the use of GenAI tools not only enhances creativity by providing new perspectives and ideas but also improves efficiency and accessibility in design tasks. The study concludes that a gradual and guided introduction of GenAI tools in the curriculum can effectively reduce resistance and increase students' confidence in their ability to leverage these technologies to their creative processes. This research contributes to the ongoing discourse on the role of AI in education and provides practical insights for educators seeking to integrate GenAI tools into their teaching methodologies.

Keywords: Artificial intelligence, AI tools, creativity, creativity techniques, design education

1 INTRODUCTION
Industrial design engineering is undergoing a transformation in its pedagogical approach. The integration of artificial intelligence (AI) into product design is revolutionising creative workflows and fostering innovation. AI-driven tools enable advancements in several key areas, including generative design, deep learning-based ideation, and interactive design assistance. Industrial design professionals recognise the significant productivity benefits of this new technology, such as increased efficiency, speed, and the automation of repetitive tasks. However, when it comes to creativity, there are differing opinions. While some professionals view AI tools as a helpful aid in overcoming the fear of the blank page, others see them as a potential risk that could lead to creative blockage [1].
Rather than replacing human designers, AI is increasingly acting as a co-creative partner. Tools like DeepArt and Artbreeder enable collaborative iteration, where designers input ideas and AI refines them. This symbiotic relationship enhances the creative process by expanding possibilities beyond human intuition. [2]. One of the most prominent applications of AI in creativity is Generative AI (GenAI), where models create novel content based on learned patterns. Its supporters in the design profession argue that GenAI accelerates the creative process through rapid prototyping and iteration [3], [4]. Tools such as OpenAI's DALL-E, MidJourney, Vizcom and DeepArt presents both opportunities and challenges within industrial design. GenAI has the potential of a constructive element in creative design into higher education, emphasising the importance of preserving authenticity and avoiding the commodification of the process [5].
Exploring Creativity Techniques (CTs) in design education is essential for developing pedagogical strategies that equip students with the skills needed for success in professional design environments. The effective use of CTs facilitates mental associations, enhances creative abilities, and enables teams to generate more ideas and better solutions in less time [6]. However, all CTs involve a learning curve, with varying levels of complexity in both comprehension and execution.
In recent years, several studies have explored the use of Generative AI (GenAI) tools to support students in applying different CTs, producing varied findings. Some educators are cautiously exploring the

incorporation of GenAI in the classroom. These initial steps are essential in helping both educators and students understand that GenAI should be used as a tool to support creativity rather than as a substitute for it [7]. For instance, research on the 6-3-5 method suggests that when AI tools are employed for idea generation, students often rely on the technology before fully exploring their own concepts [8]. In contrast, studies on brainstorming indicate that AI, when used as a support tool for ideation, can provide valuable starting points or alternative perspectives [9]. Moreover, experiments with DALL-E in brainstorming exercises revealed that an overwhelming majority of students perceived the tool as a transformative influence on their ideation and conceptualisation processes [10].

From our perspective, integrating AI into CT education offers an opportunity to foster a dynamic synergy between technology and creativity. To advance this academic discussion by incorporating GenAI tools into design education, this paper examines the integration of AI within the theoretical and practical teaching of CTs. Specifically, it focuses on how AI can address key challenges students encounter when learning these techniques. The results of this study have been highly positive, further demonstrating that well-structured classroom activities can encourage students to use AI tools effectively in conjunction with CTs.

2 METHODOLOGIES

2.1 Design and delivery of the experiment

This research is conducted within the Design and Creativity Techniques course, taught in the third year of the Bachelor's Degree in Industrial Design Engineering and New Product Development at TECNUN – School of Engineers, University of Navarra, in San Sebastián, Spain.

The course takes place during the first semester of the academic year, and this study was carried out in the 2024-25 academic year with a group of 34 students (aged 19-21; 47% male, 53% female). The group comprised 22 Spanish students, along with 1 Brazilian, 2 Americans, 1 Paraguayan, 1 Italian, 2 Uruguayan, 1 Mexican, 1 Colombian, 1 Swedish, and 1 Ecuadorian student.

The course is structured into five content units: Unit 1: History and basic concepts of creativity; Unit 2: The creative process and creative blocks; Unit 3: Context research tools; Unit 4: Creativity techniques; Unit 5: Evaluation and selection techniques.

In Unit 4, we conduct theoretical-practical sessions to teach 10 different CTs: Mind Maps, the Brainstorming family, SCAMPER, Attributes Listing, Morphological Charts, Six Thinking Hats, Analogies and Biomimetics, Microdrawing, and Morphing. Each session consists of two parts. In the first part, we introduce the foundations and methodology of each CT and provide examples of its application. In the second part, students apply the technique in teams, either in response to a challenge set by the professor or as part of their final team project developed throughout the course.

The professor has been teaching this course since the 2011-12 academic year, accumulating 13 years of experience and gaining deep insight into the challenges students commonly face when applying the various techniques covered in the curriculum. For this reason, this research has a dual objective: first, to introduce students to the use of different Generative AI tools in their creative process; and second, to demonstrate how the appropriate use of AI can help overcome specific difficulties that may arise when applying certain CTs.

Table 1 provides an overview of the CTs selected for this pilot study, the main challenges typically encountered when applying them, and the GenAI tools integrated into the course.

Table 1. CTs taught, main difficulties, and applied GenAI tools

CTs	Main difficulties of students	Generative AI
Attributes listing & Morphological charts	Difficulties in identifying a comprehensive list of attributes associated with a product and subsequently exploring the multiple possible combinations of the different proposed values for each attribute	Chat GPT, Microsoft Copilot, Google Gemini
Scamper	Difficulties in formulating relevant questions for the creative challenge from each action verb in this technique	Chat GPT, Microsoft Copilot, Google Gemini
Morphing	Challenges in diverging and generating multiple visual product concepts from the original product.	Vizcom

The integration of Generative AI (GenAI) tools in practical classes followed a structured approach. Initially, students applied the technique without using AI. Once they encountered challenges or difficulties, the use of GenAI tools was introduced with specific instructions. As the course progressed, these instructions gradually allowed for greater student autonomy. For example, in the session on the Attributes Listing technique, students were provided with precise guidance on the type of prompt to use (see Figure 1). However, in later sessions, such as the one on the SCAMPER method (see Figure 2), they were encouraged to create their own prompts and experiment with different GenAI tools using the same prompt to compare the results obtained.

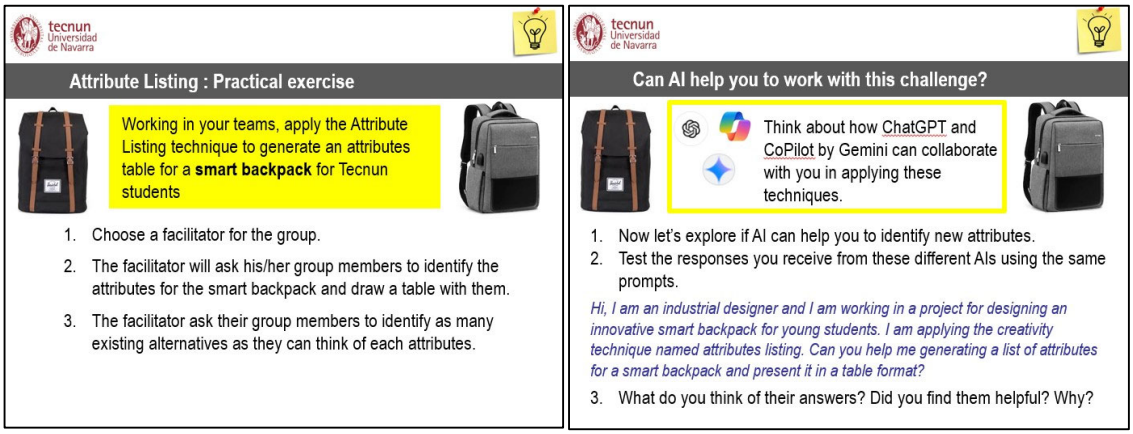

Figure 1. Instructions for the use of generative AI in a practice with Attributes listing

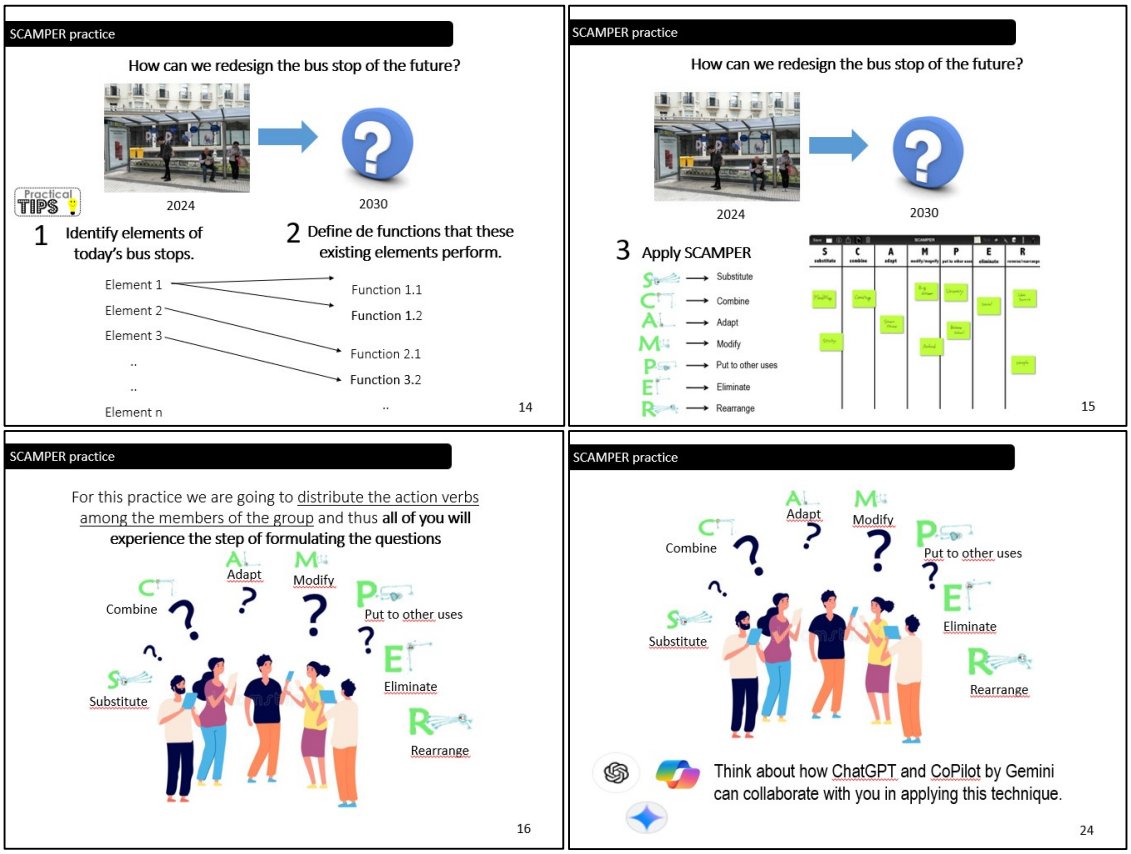

Figure 2. Instructions for the use of generative AI in a practice with SCAMPER

2.2 Evaluation of the experiment

At the start of the course, the lecturer typically introduces the course programme, explains the assessment criteria and associated activities, and presents key concepts related to creativity. In the 2024-25 academic year, a new activity was introduced during the final 30 minutes of the first class. This activity involved a team-based reflection on students' use of AI and its potential impact on their creativity. For this, students were divided into teams of three or four and asked to discuss four provided questions, presenting the conclusions of their reflection on a poster in a specified format. The first question served as an icebreaker, encouraging students to get to know each other by sharing details about their backgrounds and hobbies. The following three questions prompted a deeper discussion on their prior experiences with AI tools and their perceptions of how AI influences creativity. Figure 3 presents two examples of posters created by different groups during this activity.

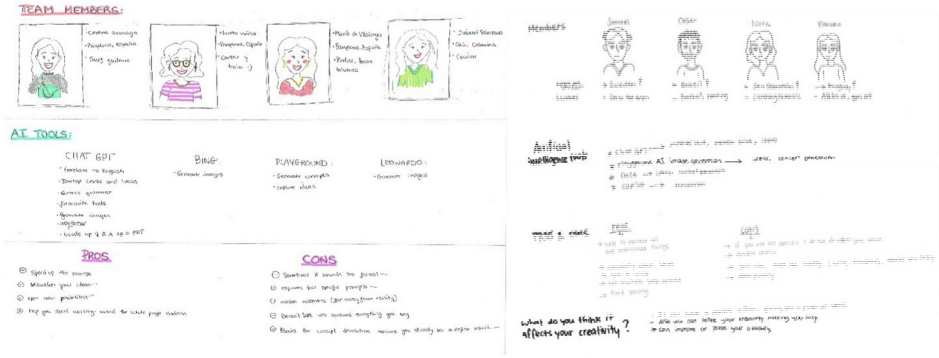

Figure 3. Posters developed by two groups at the Workshop

Students identified fourteen different AI tools and their respective applications, highlighting ChatGPT for text translation, idea development, grammar correction, and graphic generation. Bing is used for image generation and problem-solving, while Playground focus on concept and idea generation. Quillbot improves grammar and paraphrases texts while Copilot and Gemini offer ChatGPT-like functionalities. Gamma creates presentations, ChatPDF provides PDF documents analysis and tools such as Leornardo, Midjourney, Limewire or Dall-E are useful for image generation. Finally, Otter AI for audio transcriptions.

Evaluations of AI tools revealed both advantages and disadvantages. Positives included enhanced time efficiency, improved data accessibility, support for novel concepts, and learning assistance. However, concerns were raised about over-reliance on AI inhibiting creativity, potential inaccuracies, and the need for double-checking information. AI tools can inspire, increase divergence, break creative blocks, and improve communication of ideas. Negatives include mental laziness, diminished creative thinking, reduced appreciation for simple ideas, and hindered development of personal skills due to AI dependence. Originality may suffer as AI blurs authorship lines.

After the course, a voluntary and anonymous online survey using Google Forms was distributed among the students. A total of 28 students (82%) responded. The aim of the survey was to assess the impact of the experiment conducted during the course on students' perceptions of the usefulness of GenAI tools in supporting their creative processes. The questionnaire employed a mixed-methods approach to evaluate students' perceptions and experiences with AI in creative processes. The structure and types of questions in the questionnaire are detailed in Table 2. The results of the questionnaire were imported into Excel format and analysed to obtain the findings presented in the following section.

Table 2. Structure and type of questions of the questionnaire

Question number	Type of question	Qualitative or quantitative
1	1 to 10 scale	Quantitative
2	Open text	Qualitative
3	5-point Likert scale	Quantitative
4	Multiple-choice	Qualitative
5	1 to 10 scale	Quantitative
6	5-point Likert scale	Quantitative
7	Open text	Qualitative

3 RESULTS

As shown in Figure 4, most students rated the change in their perception of the usefulness of AI in creative processes as 7 or higher, with 80% of them giving such ratings. Twenty-one students highlighted a positive change in their perception of AI's effectiveness in enhancing creativity, generating ideas, and saving time. The following quote exemplifies their responses: “It has definitely changed for the better. At the beginning of the course, I thought AI generated things quickly and innovatively but without considering design and the designer's judgment. However, through each activity, I have learned that it can be a very useful tool to rely on while still maintaining an original design and respecting established limits.”

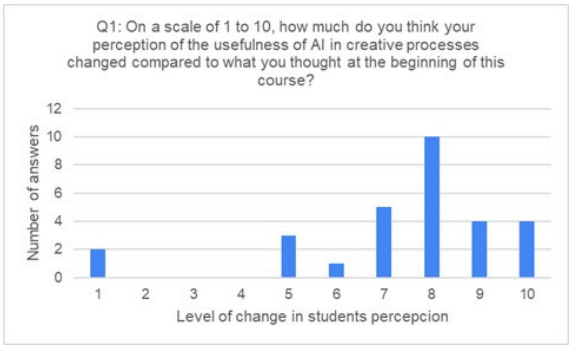

Figure 4. Evaluation of the level of change in students' perception about the usefulness of AI in creative processes

As shown in the first chart of Figure 5, 90% of the participants believe that the activities carried out in the course have provided them with practical ideas on how to incorporate AI tools into their creative processes. Furthermore, when asked to identify which creative techniques they have learned in this course where they think the use of AI could be beneficial, it is noteworthy that they not only refer to the techniques in which AI tools were used during practical sessions (SCAMPER, Attributes listing, and Morphing) but also to all the techniques they have learned in the course, as shown in the second chart of Figure 5.

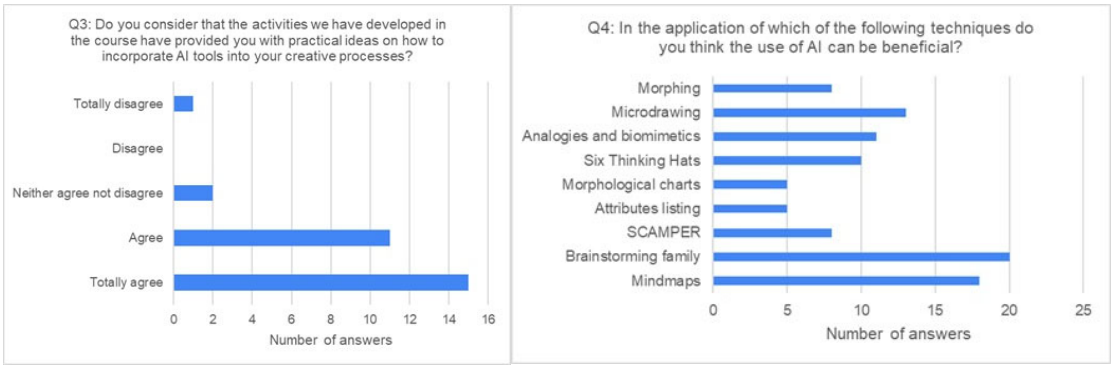

Figure 5. Evaluation of the impact of the experiment in their capacity of apply AI tools in their creative process

When asked about their confidence in using AI tools in their creative work after this experience, 76% of the participants rated their confidence as 7 or higher. Additionally, a significant majority of participants believe that the knowledge they acquired is applicable to their future projects. These results indicate a strong positive reception towards the integration of AI in creative processes.

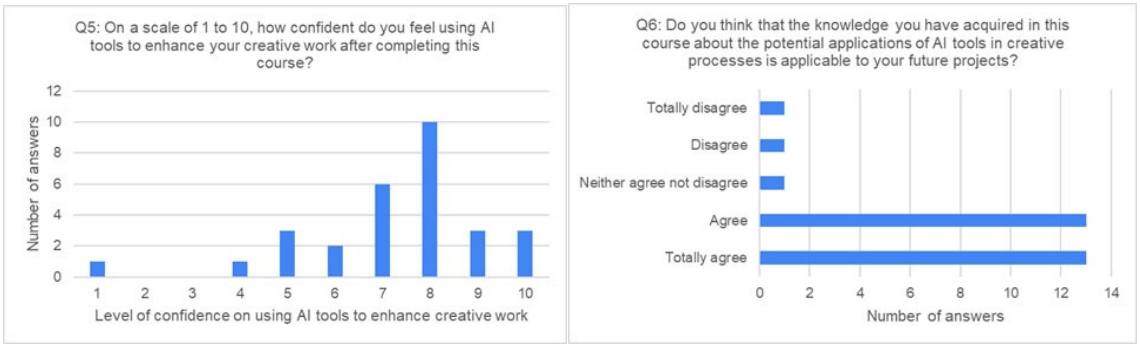

Figure 6. Evaluation of confidence using AI tools in creative work and application on future projects

Although the results are very positive, it is important to highlight some limitations of the study, such as the limited sample size, the reliance on students' self-perception, and the short-term measurement of the pilot test's effects. Future research should address these limitations to achieve a comprehensive understanding of long-term and generalisable results.

4 CONCLUSIONS

The integration of GenAI tools in design education has shown to positively impact students' confidence and mastery of CTs. The gradual introduction of these tools, guided by experienced educators, helps reduce resistance and fosters a more positive perception of AI's role in creative processes. Students reported increased efficiency and accessibility in applying CTs, highlighting the potential of GenAI to enhance educational outcomes. Future research should explore long-term impacts in bigger samples and further refine the integration strategies to maximise the benefits of GenAI in mastering CTs.

REFERENCES

[1] Rodriguez-Ferradas M. I., Cantós C., Viñeta, L. and Morer P. How will the emergence of AI in the world of industrial design change the training needs of our students? In *DS 131: Proceedings of the International Conference on Engineering and Product Design Education, E&PDE 2024,* Birmingham, September 2024, pp. 473-478.

[2] Boden M. *Creativity and AI: Can Machines Be Creative?* 2019 (MIT Press., Cambridge-Massachusetts)

[3] Pennefather P. P. Creative prototyping with generative AI: Augmenting creative workflows with generative AI, 2023 (Apress, New York).

[4] Verganti R., Vendraminelli L. and Iansiti M. Innovation and design in the age of artificial intelligence. *Journal of product innovation management*, 2020, 37(3), 212-227.

[5] Fleischmann K. The commodification of creativity: Integrating Generative Artificial Intelligence in higher education design curriculum. Innovations in Education and Teaching International, 2024, pp. 1-15

[6] Bertoncelli T., Mayer O. and Lynass M. Creativity, learning techniques and TRIZ, *Procedia Cirp*, 2016, Vol. 39, pp. 191-196.

[7] Fleischmann K. Making the case for introducing generative artificial intelligence (AI) into design curricula. *Art, Design & Communication in Higher Education*, 2024, 23(2), 187-207.

[8] Hamilton V., Brisco R. and Grierson H. How can AI support the creation of novel ideas in product design. In *DS 131: Proceedings of the International Conference on Engineering and Product Design Education, E&PDE 2024,* Birmingham, September 2024, pp. 133-138.

[9] Gong Z., Paananen S. and Nurmela P. (2024). AI role in ideation for design creativity enhancement. In *DS 136: Proceedings of the Asia Design and Innovation Conference (ADIC)* 2024, pp. 046-054).

[10] Omran Zailuddin M. F. N., Nik Harun N. A., Abdul Rahim H. A., Kamaruzaman A. F., Berahim M. H., Harun M. H. and Ibrahim Y. Redefining creative education: a case study analysis of AI in design courses. *Journal of Research in Innovative Teaching & Learning*, 2024, 17(2), 282-296.