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THE CHALLENGES OF TEACHING CREATIVITY USING ARTIFICIAL INTELLIGENCE

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ABSTRACT
In recent years, we have quickly entered a new era that has challenged all areas of life. It seems that some old methods are less efficient than modern methods for doing various things. Educational fields should be updated for future generations, especially design education and related specialties. This research explores methodologies for teaching creativity while preserving the innate human capabilities of designers and examines the use of artificial intelligence (AI) as a creative teaching aid. A problem was presented to three student groups during a brainstorming session, and their ideas were compared to solutions generated by AI platforms. The results show that while students produced a greater variety of creative ideas, their familiarity with the problem's context led to some differences compared to the AI, which lacked environmental context. The challenges of teaching creativity using AI can vary based on psychological, geographical, cultural, and economic factors. Critically analysing AI results requires expertise in creativity. Group meetings can effectively teach critical and multifaceted thinking to Generation Z students. The research suggests that intelligent and thoughtful integration of AI in design education, combined with human feedback and guidance, can enhance the creative problem-solving process.

Keywords: Education, creativity, industrial design, artificial intelligence, brainstorming

1 INTRODUCTION
Presenting new ideas is the most important professional duty of designers and for this reason, it is necessary to identify creativity and problem-solving methods in order to achieve design goals. in the rapidly advancing digital era, artificial intelligence (AI) has permeated various fields, including design education, presenting both challenges and opportunities for training the next generation of designers. As digital natives heavily reliant on technology, today's students must develop creative and critical thinking skills before engaging with AI platforms.
In this research, while holding ideation sessions by students, it is tried to teach the variety of viewpoints of dealing with issues and factors affecting them. This research investigates methods for nurturing creativity while leveraging AI as a teaching assistant, aiming to address key questions:

- What are the challenges for teaching creativity using AI?
- How do the quantity, diversity, and quality of student-generated ideas compare to AI-generated solutions?
- What is the most suitable method for using artificial intelligence in design education?

2 LITERATURE REVIEW
As we progress into an era increasingly shaped by artificial intelligence (AI), it becomes crucial to interrogate how AI might impact design education, both as a potential threat to and an augmentation of human creativity. Today, most undergraduate and graduate students are one of the first generations to grow up in a fully digital world, with easy access to technology, smartphones, the Internet and fast communication from the youngest age. They have witnessed the emergence of social media platforms, instant and extensive digital communication, and as a result, they are heavily dependent on technology in the digital world and information and communication in global networks and are used to using them. The burgeoning field of AI in education has demonstrated the potential for AI to streamline tasks, adapt instruction, and provide personalised support [1], [2]. Gen Z may not have great critical thinking or information literacy skills [3], [4]. Institutions should focus on creating learning environments that foster

the development of digital literacy and technological skills, along with providing opportunities for students to apply their learning in real-world contexts.
Given that literature has found Gen Z to be more likely to trust information found online due their lack of critical thinking skills [5], it is important to ensure students are able to recognise instances in which information may be disingenuous or inaccurate and when fact-checking and validation is necessary.
Design thinking's reliance on divergent thinking and subjective interpretation presents challenges for AI, necessitating a careful mapping of its strengths and limitations in creative problem-solving. Starting with simple brainstorming methods and examining the challenges for both students and AI can help determine the advantages and disadvantages at each step.

3 METHODOLOGIES

Based on several years of teaching experience and knowledge of creativity training methods, it was decided to make a comparison between students' brainstorming and the possibility of artificial intelligence brainstorming. Therefore, the most common individual and group brainstorming techniques were selected, and a comparison was made at each stage. Training individual brainstorming methods based on Tony Buzan's instructions from the book "Head First! You're Smarter Than You Think" [6] were selected.
Task design: The stages of the task were defined and implemented in several stages as follows:

- Participation of volunteer students in a creativity training course,
- Formation of multiple teams to participate in the brainstorming session,
- Stating the topic of the brainstorming session and presenting ideas to solve the related problem,
- Classifying ideas from different perspectives,
- Presenting the topic by each group to the accessible artificial intelligence platform using mobile,
- Summarising the results of students' work and comparing them with the answers of artificial intelligence,
- Repeated use of top three AI platforms OpenAI (GPT4), Google (Gemini 1.5) and Anthropic (Claude3 Opus).

3.1 Brainstorming by Students

Three problems were presented to eight student groups (1-1 to 1-8) in brainstorming sessions. Participants were undergraduate (ages 20-24) and graduate (ages 25-30) industrial design students. Groups 1-1 to 1-5 had prior training in creative thinking, with varying environmental conditions and problem familiarity. Groups 1-6 to 1-8 had different levels of prior creativity training and brainstormed under varied conditions. Table 1 summarises the group conditions and ideation results, showing the impact of educational background, environment, and mental state on idea quantity, quality, and categorisation.
The question or description of the topics of each group is as follows:

1. What can be done to help a blind person cross the street safely?
2. What could be the reason if a person is sitting in a park holding a newspaper upside down?
3. Many people smoke cigarettes every day in a specific green space and the cigarette smoke bothers the employees of the ground floor in the adjacent building. How can this problem be solved?
4. Repeat the same problem number 3-1-3.
5. Repeat the same problem number 3-1-3.
6. Repeat the same problem number 3-1-3 with the difference that the environment where the problem occurred was unspecified and the definition of the problem was presented as follows: Imagine an unspecified green space and an imaginary modern building and the ideal conditions for implementing any idea (group consisting of first semester undergraduate students who did not have experience with creative thinking enhancement exercises).
7. Repeat the same problem 1-6 for first-year graduate students who all had positive energy.
8. Repeat the same problem 1-6 for first-year graduate students who had a little stress.

In all meetings, the number of members of each group was eight people and the idea generation time was 20 minutes. The total time of each session was about an hour for the gathering and preparation of the meeting and the operation after it.

Table 1. Comparison of students' brainstorming conditions and Number of Ideas

Group Code	Question and Problem Posed for Brainstorming	Environmental Conditions	Familiarity with Creativity Methods	Number of Ideas	Number of Classifications
3-1-1	Help a blind person cross the street	Suitable and no stress	Yes	72	-
3-1-2	A person with an upside-down newspaper	Suitable and no stress	Yes	81	-
3-1-3	Office employees and cigarette smoke problem	Crowded and tolerable stress	Yes	93	5
3-1-4	Office employees and cigarette smoke problem	Crowded and tolerable stress	Yes	47	2
3-1-5	Office employees and cigarette smoke problem	Crowded and tolerable stress	Yes	59	8
3-1-6	Office employees and cigarette smoke problem	Crowded and tolerable stress	No	19	2
3-1-7	Office employees and cigarette smoke problem	Crowded and tolerable stress	Yes	80	7
3-1-8	Office employees and cigarette smoke problem	Crowded and tolerable stress	Yes	36	5

According to Table No. 1, the comparison between the idea generation results of different groups of students shows that the difference in educational background, environmental conditions, and mental state can be effective in the quantity and quality of ideas, their classification and variety.
These are some of the challenges of teaching creativity in ordinary situations. The comparison of the results of each group showed the students that with different lenses and perspectives of dealing with the subject, different results can be reached. After completing the idea generation, the students were asked to categorise their group's ideas and choose the titles of each category.

Table 2. The titles of categories of students' ideas

Group	Number of Categories	Category titles	Cat. Codes
3-1-3	5	Product	A
		Jokes	B
		Change of activity	C
		displacement	D
		Impossible ideas	E
3-1-4	2	possible ideas	F
		Impossible ideas	G
3-1-5	8	Practical tools	A
		Jokes	B
		Creating attraction in the environment	D
		Creating repulsion in the environment	D
		Remove the problem statement	H
3-1-6	2	logical	L
		illogical	M
3-1-7	7	Architecture	D
		culture	N
		Technology	A
		Movement	D
		policy	K
		product	A
		Hygiene	O
3-1-8	5	Inexpensive	P
		Expensive	Q
		non-executive	F

		incentive system	I			executive	G
		Punishment system	J			creative	R
		Legislation	K				

3.1.1 The results of students' ideation

Considering the variety of classification of ideas, it can be seen that the participation of students in the group meeting increases the ability to present ideas with different points of view. According to the defined task groups 3 to 8, immediately after the completion of ideation, have categorised their ideas from various points of view (Table 2), which can be summarised under the following headings: a) product design, b) changes in the environment, c) policy making, d) behavioural and cultural, e) economic, f) jokes, g) non-executive ideas. Attending groups and exchanging work results is very effective in increasing the horizons of beginner students, but it takes at least 60 minutes to manage the meeting and complete the entire work.

3.2 Using Artificial Intelligence

The same brainstorming questions were posed to the AI platforms using two methods:

3.2.1 Zero-Shot Questions (ZS)

In this method, the AI model is asked to generate responses to the brainstorming questions without being given any explicit instructions or examples of what is expected. It's similar to asking a person to come up with ideas off the top of their head, without providing them with any guidelines or prompts. The AI relies solely on its existing knowledge and training to understand the question and generate relevant ideas. This approach tests the AI's ability to interpret and respond to questions without additional guidance.

3.2.2 With Instruction: (Max_token=4000, Temperature=1.0, Method=CoT)

This method involves providing the AI model with specific instructions and parameters to guide its idea generation process. It's like giving a person a detailed brief or a set of rules to follow when brainstorming. The researchers specify factors such as:

- The methods or techniques the AI should use to generate ideas (e.g., mind mapping, lateral thinking)
- The number of ideas the AI should generate for each question.
- How the AI should categorise or organise its generated ideas

By setting these parameters, the researchers can control and optimise the AI's output to better suit the task at hand. This approach is also known as "prompt engineering," as the instructions given to the AI are carefully designed to elicit the desired type and quality of responses. Providing more context and guidance can help the AI generate ideas that are more relevant, diverse, and aligned with the researchers' expectations. Table 3 compares the number of AI-generated ideas using both methods, showing that detailed instructions yield more results. Table 4 assesses the quality of AI responses based on expert ranking, demonstrating the importance of human feedback in selecting appropriate solutions. Figures 1 and 2 illustrate the improvement in AI performance with instruction and the comparison between engineered prompts and zero-shot questioning.

3.2.3 Selected Questions

1 What can be done to help a blind person cross the street safely?
2 What could be the reason if a person is sitting in a park holding a newspaper upside down?
3 Many people smoke cigarettes every day in a specific green space and the cigarette smoke bothers the employees of the ground floor in the adjacent building. How can this problem be solved?

We don't need to set stress or education levels for AI so there are only three questions.
Table 3 shows the results of two methods of using three selected AI tools. The numbers in the columns clearly indicate that more results from AI responses can be achieved by using engineered instructions and more detailed explanations.

Table 3. Comparison Number of ideas generated by AI

Questions	OpenAI (GPT-4)		Google (Gemini 1.5)		Anthropic (Claud 3)	
	ZS	Instruction	ZS	Instruction	ZS	Instruction
1	10	100	16	22	8	30
2	8	40	10	36	7	70
3	8	39	11	27	6	30

The results of the responses of the three AI platforms are shown in Table 4. The number of categories and the number of selected answers is written in each row. For the qualitative ranking of the answers, it is necessary to use human feedback and here the experience of a subject matter expert (SME). The ranking results are based on the number of answers and their quality selected by an expert.

Table 4. Quality of ideas generated by AI

AI Model	Output Structure		SME Ranking	Result
	Category	Selection		
OpenAI (GPT-4)	3-4-2	12-12-8	3	Useful
Google (Gemini 1.5)	5-6-5	15-3-10	2	Average
Anthropic (Claud 3)	3-4-10	6-16-30	1	Strong

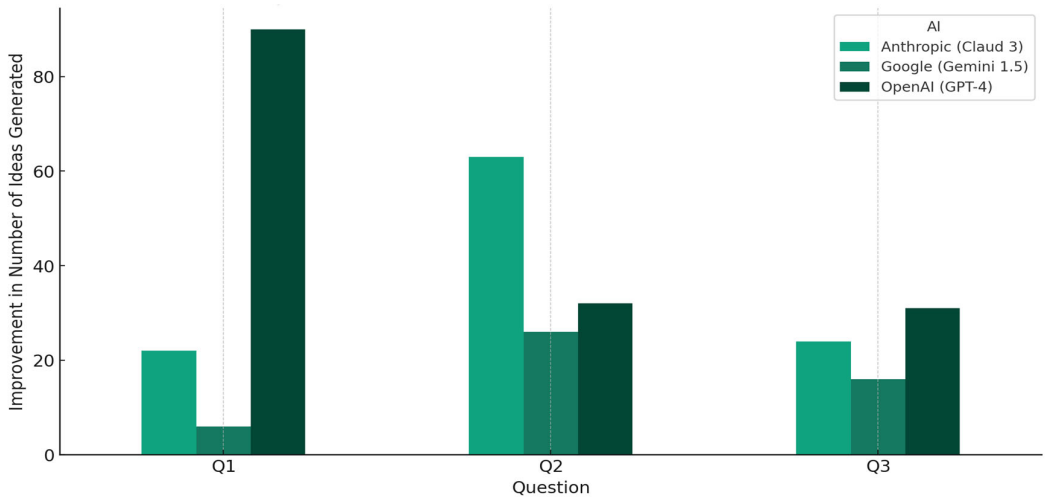

Figure 1. improvement in AI Generated Ideas with Instruction or Prompt Engineering

Figure 1 shows the enhancement of AI-generated ideas by instruction or prompt engineering. Despite the improvement of the statistics of the number of answers, human feedback should be used to make decisions and select answers.

4 RESULTS

The analysis reveals the influence of students' environmental conditions and academic status on ideation. The 29 identified idea categories highlight the diverse perspectives humans bring to problem-solving. While AI can generate a large volume of responses, their novelty, creativity, and quality require careful evaluation. Controlled, precise commands can enhance the quality of AI-generated ideas. Table No. 5 shows the most important positive and negative aspects between the students' idea creation and the production of artificial intelligence answers.

Table 5. Comparison between students and artificial intelligence

Aspect	Students	AI
Positive	- May have Multifaceted thinking	- High speed responses
	- More creative ideas	- Real-time classification of responses
	- Strong imagination	- No limitation for presenting new responses
	- Influenced by sympathy	- Not affected by environmental factors
Negative	- Lack of self-confidence	- May be biased
	- Affected by environment	- Full energy consumption
	-Affected by psychological factors	- Ideas depend on imported data
	- Fear of ideas being ridiculed	- Possible mistakes

5 DISCUSSION AND CONCLUSION

Teaching creativity using AI presents challenges across psychological, geographical, cultural, and economic dimensions. Demonstrating the value of group meetings in fostering critical and multifaceted thinking is crucial for engaging Generation Z students. Lack of experience in working with AI may lead to inaccurate results, necessitating the guidance of creativity experts. The perceived novelty of ideas may vary across geographical contexts, emphasising the importance of AI's access to diverse resources. Economic disparities can limit access to high-speed internet and AI tools, impacting the quality of results. This research highlights the potential of thoughtfully integrating AI in design education while underscoring the indispensable role of human expertise and collaboration. The educational application of this research includes using AI as a personal assistant for brainstorming training, expanding the quantity and diversity of ideas generated, and strengthening students' critical thinking abilities through AI collaboration. By leveraging AI's capabilities and human guidance, educators can create a learning environment that nurtures creativity, critical thinking, and adaptability in the next generation of designers, equipping them with the skills necessary to navigate an increasingly complex professional landscape.

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