Text Stimuli Created by Generative AI in Ideation: An Exploratory Study

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Abstract: This study examines the convergence of artificial intelligence (AI) and human design, specifically emphasizing the influence of text stimulus created by Generative AI on ideation. The findings demonstrate an impact of Generative AI on the process of generating ideas. Reflective evidence indicates that individuals have a favorable view of how AI positively influences them to generate ideas. This study enhances our knowledge of the potential advantages of incorporating Generative AI into the early stage of design and promotes investigation into AI-supported design and education.

Keywords: Text Stimulus, Generative AI, GPT, Ideation, Idea Generation, Design Creativity

1. Introduction

The intersection of machine capabilities with human design in the field of artificial intelligence (AI) has led to a significant and transformational change in many fields, such as design (Gero and Sudweeks, 2012). Generative AI, a remarkable technology, is at the forefront of this progress (Thoring et al., 2023). The influence of advancing Generative AI technologies on design is becoming more and more noticeable (Ooi et al., 2023). AI models have gained prominence in the creative toolbox due to their capacity to produce coherent and contextually appropriate content (Joosten et al., 2024; Kim et al., 2021; Zhang et al., 2023), such as in ideation context (Cai et al., 2023).

Although Generative AI provides substantial assistance to individuals in some activities, such as in ideation, researchers have put up ten areas for further investigation, such as guided prompts (Thoring et al., 2023). Therefore, our study aims to explore how guided prompts (text stimuli created by Generative AI) stimulate students in ideation. The subsequent sections of this article will be presented in the following manner. Section 2 provides a background for the current study. Then, we explore the approach by discussing the design and implementation of our experiments in section 3. The subsequent section 4 provides analyses of data gathered in the study. This is followed by a discussion in section 5, where we explore the insights gained from our research. In conclusion, we provide our findings, acknowledge the limitations, and the possible contributions to the ongoing conversation on AI-assisted design in section 6.

2. Background

2.1. Idea generation and development

Idea generation and development, seen via a design lens, are essential elements of the creative process, playing a critical role in generating groundbreaking solutions. Idea generation in design entails using divergent thinking to examine a broad spectrum of possibilities (Gonçalves and Cash, 2021). The following idea development is crucial for refining feasible solutions that are in line with the project objectives and user requirements (Kelley and Kelley, 2013). This is consistent with the iterative nature of design thinking, in which the process involves several iterations and feedback loops that are essential for refining and choosing concepts (Brown, 2008; Gonçalves and Cash, 2021). The process of ideation is an intricate cognitive activity, influenced by both internal and external influences and inspirations (Amabile, 2011; Gonçalves et al., 2014; Gonçalves and Cash, 2021; Gong et al., 2022; Gong and Georgiev, 2020). A stance with a long history in AI-supported creative design is that of support of computational creativity and support of idea development (Brisco et al., 2023; Sosa and Gero, 2016).

2.2. AI stimuli in idea generation

A variety of ideas has been identified as research opportunities for iterative interplay between human designers and AI (Thoring et al., 2023). Text stimuli are one of these, which could be produced by Generative AI, function as a flexible and adaptable tool for generating ideas, demonstrating the capabilities of natural language processing in promoting creativity (Devi et al., 2023). Generative AI, such as ChatGPT, utilizes a sophisticated language model to generate coherent and contextually appropriate text, covering a wide range of subjects. The text stimuli produced by ChatGPT may serve as prompts, catalysts, or sources of inspiration for ideation processes in several domains. ChatGPT's text stimuli facilitate the

investigation of diverse language formulations and mental perspectives, hence expanding the range of creative thinking (Liu et al., 2023). The use of AI-generated text stimuli in the process of generating ideas showcases the changing field of artificial intelligence and emphasizes the possible collaboration between human creativity and machine-generated material (Guo et al., 2023; Urban et al., 2024).

This current research seeks to unravel the influences of Generative AI-produced text stimuli infiltrating ideation. Specifically, our research endeavors to answer a research question: Could Generative AI stimulate students in ideation?

To answer the research question, we conducted a pilot study in a creative design course. The course aims to assist students (master's and doctoral students) in understanding and applying basic creative problem-solving and design thinking approaches in practice. In addition, the course aims to help students systematically ideate and implement creative solutions to a problem, both independently and within a team. Further, it encourages students to apply creative design thinking and low-resolution prototyping, emphasizing empathy, iterative strategies, and interactions.

3. Case study

3.1 Adopted Group Creativity Technique

The exercise incorporated the 6-3-5 technique as it aligns with the pedagogical objectives of our courses, which emphasize the cultivation of creative methodologies and the promotion of design thinking. The 6-3-5 method was initially formulated by Bernd Rohrbach (Rohrbach, 1969) in the German language. Subsequently, various scholars, including Baruah and Paulus (2019) and Shah (1993), further explored and refined this method throughout the last several decades. The exercise was done following the 6-3-5 method as described by several researchers (Gong et al., 2023b, 2023a; Schröer et al., 2010) with a group consisting of three individuals. It should be noted that groups with less than six members are also considered appropriate, as stated by Linsey et al. (2005). In accordance with the 6-3-5 method, the participants were instructed to generate five ideas on a worksheet within a certain time frame, as seen in Figure 1 (a). Subsequently, the worksheet was passed on to the next team member, who was tasked with contributing additional ideas to the current ones, as illustrated in Figure 1 (b) and (c). The aforementioned procedure is iterated until every member of the group has made their contribution and the worksheet has been completed and subsequently returned to the original contributor, as seen in Figure 1 (a).

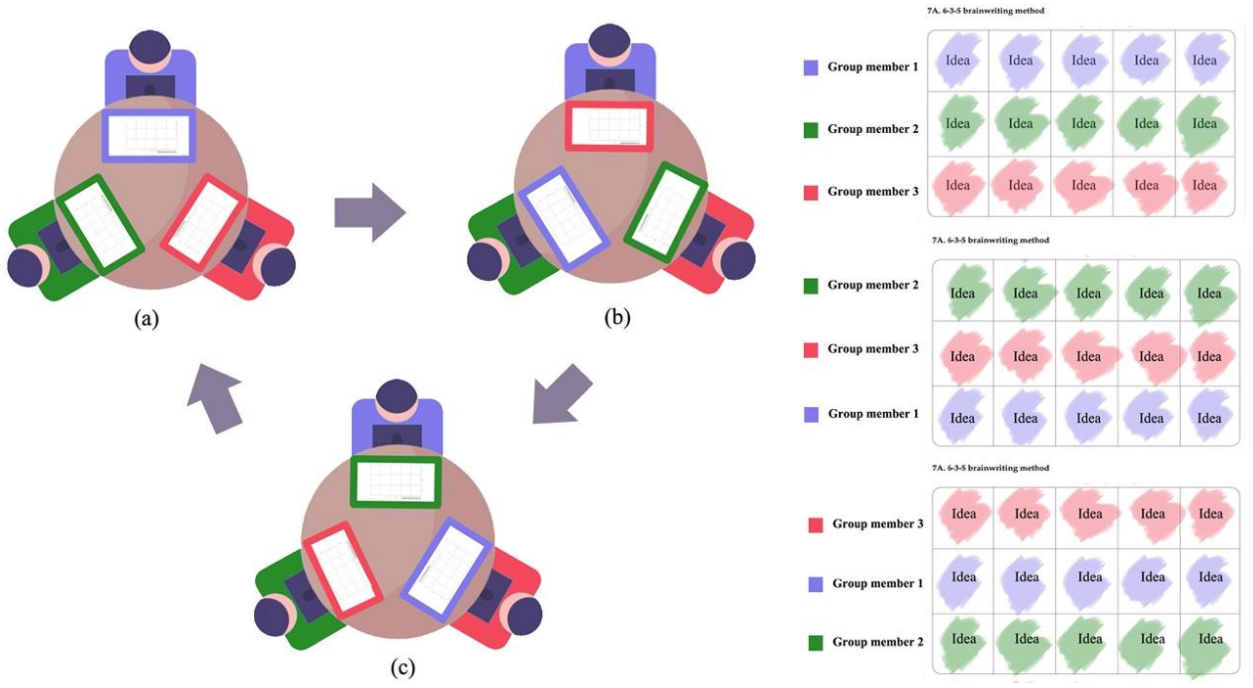

Figure 1. Steps of adopted creative methods and their worksheets.

3.2 Study Set Up

The use of stimuli (texts generated by Generative AI) was implemented in an exercise conducted during a creative design course. This particular course spans a duration of seven weeks and is designed to foster comprehension and application of fundamental creative problem-solving techniques and design thinking approaches. In total 26 participants participated in the exercise who were enrolled in either master's or PhD programs across several disciplines, such as computer science

and engineering. The average age of the 26 participants included in the study was 25.35 years, and the standard deviation was 2.95 years. Furthermore, 11.54% of the participants identified as female, while the majority, around 88.46%, identified as male. The exercise encompassed four group ideation exercises in a design task, adopting the creative method of 6-3-5, as explained in the last section.

Figure 2. Procedure of the exercise.

During the exercise (Figure 2), the instructor initially provided an explanation of the 6-3-5 method and ensured that all participants possessed a comprehensive understanding of its application. Subsequently, the participants were requested to employ the 6-3-5 method in groups to devise a product that facilitates independent sleep for children between the ages of 3 and 5, taking into account their developmental requirements, anxieties, and sense of security. Subsequently, the instructors presented the text stimuli produced by Generative AI (ChatGPT-4), as shown in Figure 3. Afterwards, the participants were instructed to once again employ the identical creative method to develop ideas pertaining to the aforementioned task. The final step was to discuss and count the number of ideas they generated and select the best ideas from their opinions. We used “best ideas” in the paper, which were not evaluated by experts but selected by participants themselves.

Product Name:	DreamGuard Buddy
Product Description:	The "DreamGuard Buddy" is a comforting and interactive sleep aid designed to help young children transition to sleeping alone in their own beds. It combines elements of a plush toy with innovative technology to create a reassuring bedtime companion.
Key Features:	• Soft Plush Toy: The DreamGuard Buddy is a cuddly, soft, and huggable plush toy available in various animal or character designs, which can become the child's sleeping buddy. • Interactive Features: The Buddy comes equipped with interactive elements such as gentle LED lights, soothing lullabies, and a calming nightlight. These features can be activated through simple touch or voice commands, providing a sense of control and reassurance to the child. • Bedtime Routine Reminder: The product can be programmed to follow a bedtime routine. For instance, it can softly announce when it's time to brush teeth, read a bedtime story, or go to sleep. This helps establish a structured routine for the child. • Parental Control App: Parents can control and monitor the DreamGuard Buddy via a smartphone app. The app allows them to adjust settings, play voice messages of comfort and reassurance, and keep an eye on the child's sleep patterns. • Security Blanket Pocket: The plush toy has a pocket where a small security blanket or a piece of the child's clothing can be placed, making it even more comforting and familiar. • Voice Recognition: The Buddy can respond to the child's voice commands and even engage in simple conversations, offering companionship when needed.
Benefits:	• Comfort and Reassurance: The DreamGuard Buddy provides a comforting presence for children, helping them feel secure in their own beds. • Establishing a Routine: The product assists in creating a bedtime routine, reinforcing good sleep habits. • Independence: It promotes a sense of independence as children learn to self-soothe and fall asleep on their own. • Parental Involvement: The companion app allows parents to actively participate in the bedtime routine even when they are not in the room. • Gradual Transition: The DreamGuard Buddy can be gradually phased out as the child becomes more accustomed to sleeping alone.
Safety:	Safety is paramount, especially for a product designed for young children. The DreamGuard Buddy should be made from hypoallergenic, non-toxic materials, with no small parts that could be a choking hazard. Additionally, the interactive features should be designed with child safety in mind, including tamper-resistant battery compartments and secure stitching.

In conclusion, the "DreamGuard Buddy" is designed to provide comfort, support, and a structured routine for young children as they learn to sleep alone through the night. It combines the familiarity of a plush toy with interactive technology, ensuring a smooth transition to independent sleeping for both children and parents.

Figure 3. The presented stimulus

3.3 Analysis

We conducted data analysis using the participants' output in ideation and accompanying weekly submitted documentation. Regarding qualitative data, all authors collaborated in analyzing the participants' ideas on the worksheet. The quantitative data was processed using SPSS (IBM SPSS Statistics 26.0).

4. Results

As part of within-subjects research, we instructed the participants to tally the quantity of ideas for each worksheet both before and after the stimulation. Furthermore, we have determined the source of their best ideas (preferred ideas they selected), which might be inspired by their fellow group members or text stimuli produced by Generative AI. Moreover, the researchers in our study reviewed the documentation that they updated as their reflections.

4.1 Number of ideas

A total of 559 ideas were produced by the 26 participants, in which before exposure to the text stimulus is 290, and after exposure to the stimulus is 269. A paired-sample t-test was used to test whether there was a statistically significant disparity in the mean number of ideas before and after exposure to the text stimulus. No statistically significant difference was seen before (11.15 ± 2.78) and after (10.31 ± 3.08), determined by $p = .131$. After being exposed to the text stimulus, 17 participants generated fewer ideas than before, 6 participants generated more ideas than before, and 3 participants generated the same number of ideas as before.

4.2 Best ideas

The participants chose a total of 52 ideas as their best ideas from their two worksheets (both before and after the stimulation). We examined 26 ideas from the worksheet after the participants were exposed to the text stimulus. The inspiration of the 26 ideas, which were classified into three groups by the authors of this work. These categories include ideas **inspired by group members**, **ideas inspired by the text stimulus**, and **ideas inspired by both group members** and **the text stimulus created by Generative AI**. More precisely, if the best idea was developed based on the input and remarks of the group members, it was classified as being inspired by the group members. Figure 4 (a) illustrates an example where the participant worksheet is shown on the left side, prior to being exposed to the text stimuli, which the other two group members developed based on the initial ideas. The figure on the right, labeled as Figure 4 (a), depicts the individual's worksheet after exposure to the text stimulus. On this worksheet, the individual highlighted their best ideas, which integrated their own ideas with the input provided by their group members. The best idea derived from the text stimulus is classified as being inspired by the text stimulus, as seen in Figure 4 (b), where the right side of Figure 4 (b) represents the worksheet after exposure to the text stimulus. The participants generated and picked the best idea inspired by the text stimulus, namely the feature of voice recognition, rather than from the preceding worksheet before being exposed to the text stimulus. When the participants combined group members' contributions and the features shown in the text stimulus and developed their best idea that was classified as inspired by both group members and the text stimulus created by Generative AI. We analyzed 10 participants inspired by group members when they developed their best ideas, 11 participants inspired by text stimulus, and another 5 participants inspired by both.

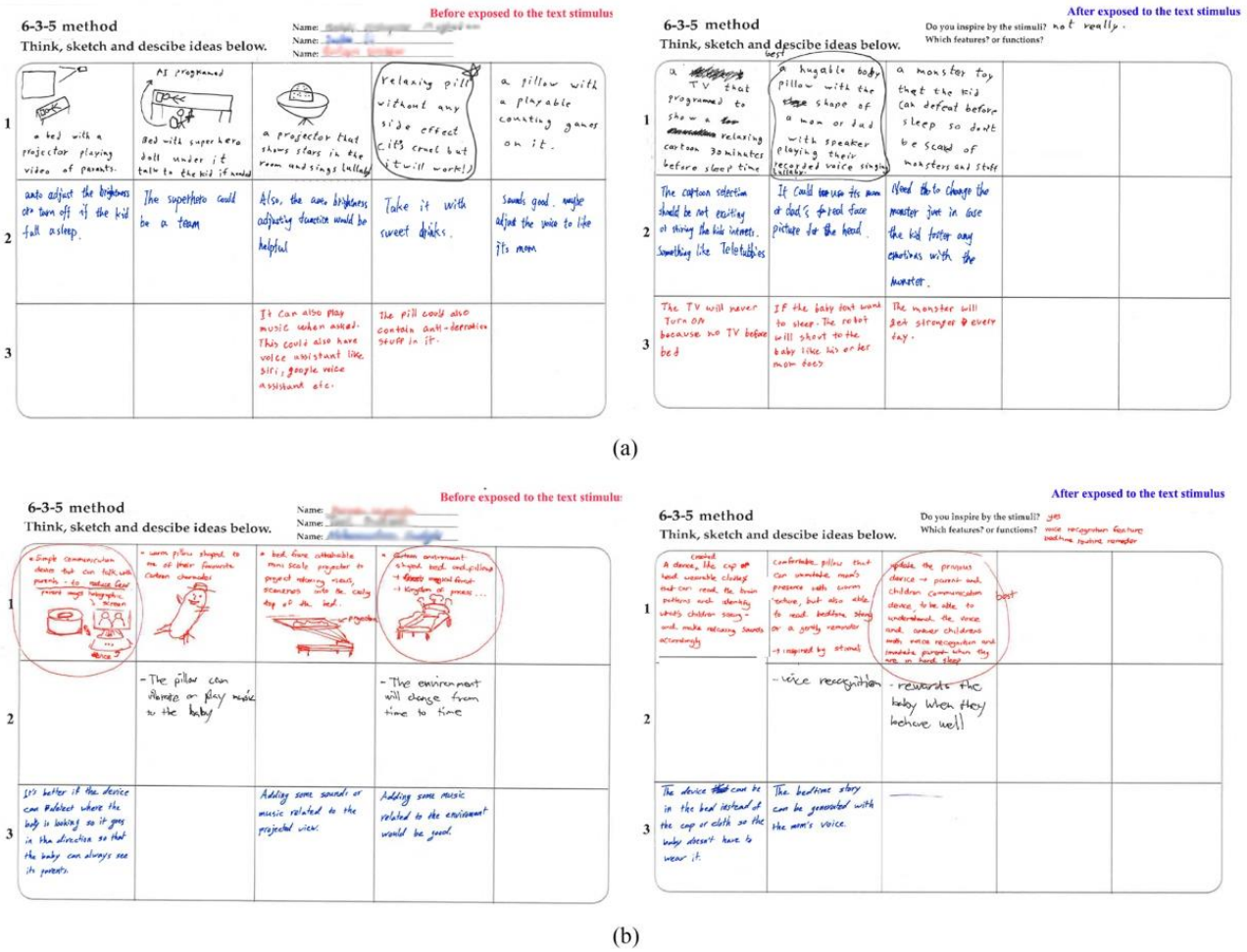

Figure 4. Examples of the best ideas before and after being exposed to the text stimulus

4.3 Refection of ideation

We collected 18 instances of reflective documentation from 18 participants, while the other 8 individuals just submitted their worksheets without including any thoughts on the exercises. Approximately one-third of the participants acknowledged the impact of text stimuli on ideation, with the majority expressing the advantages of text stimuli for generating ideas**,** which is discussed in the subsequent section 5.

5. Discussion

The text stimulus produced by Generative AI has a beneficial impact on participants' ideation, aiding them in generating their best ideas. Over 50% of the participants' best ideas were influenced by the text stimulus generated by Generative AI, which were categorized into six groups: *soft plush toy*, *interactive features*, *bedtime routine reminder*, *parental control app*, *security blanket pocket*, and *voice recognition*. As shown in Figure 5, the parental control app is the most frequently used feature in participants' best ideas. For example, participant 22 generated and selected the best idea, "an app that will ask for the most important tasks of the day from people and will keep pointing it out if they have not finished," and he stated that he was inspired by the feature of the parental control app. The features of bedtime routine reminder, voice recognition and interactive feature as the popular features used in participants' best ideas, 6, 5 and 4 participants used these features in their best ideas, respectively, such as participant 15. His best idea is a lateral cushion that enables the youngster to engage in conversation, while also being customizable to include their preferred superhero or cartoon character. This may be managed with a smartphone application or by voice command. It is possible that there are just a limited number of touch controllers. The security blanket pocket and soft plush toy are underutilized aspects of the text stimulation. The participants did not choose these connected ideas as their best ideas since the soft plush toy is a popular choice among newborns and kids. The purpose of the security blanket pocket is to provide children with a sense of comfort and familiarity. For the same aim (i.e., a sense of comfort and familiarity), participants produced more creative ideas compared to the text stimulus, such as placing a toy in bed with a human shape wearing their parents' clothes. Therefore, we found that more than half of the participants were inspired by text stimulus negated by Generative AI, and half of the features of the text stimulus were helpful for participants in generating their best ideas.

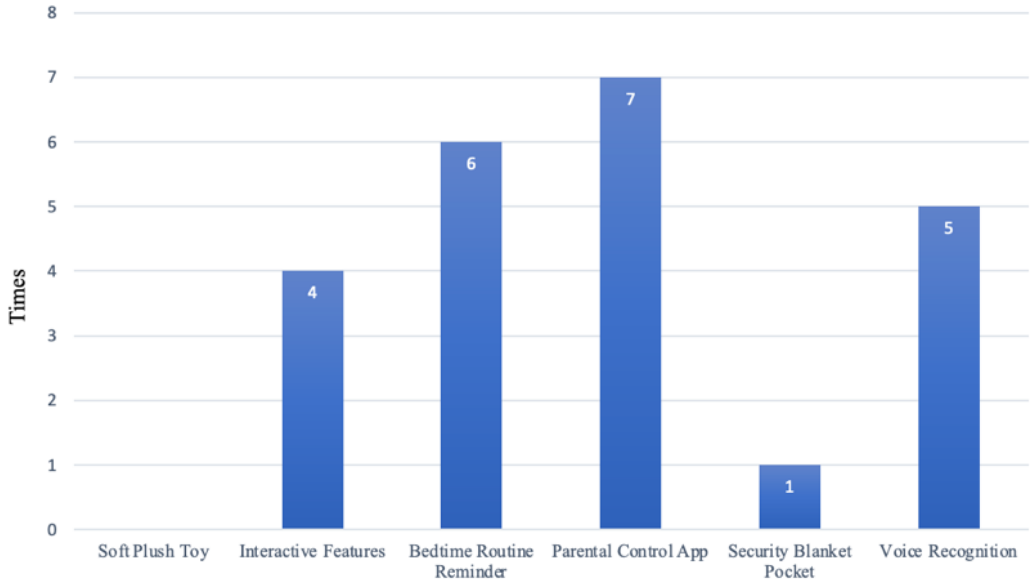

Figure 5. The features provided by text stimulus and the times used the features by participants

Around ten participants mentioned the text stimulus and the Generative AI in ideation. The majority of them (seven participants) benefited from the text stimulus and mentioned the two ways in which their ideas were influenced by the text stimulus. **First,** the text stimulus guided them to generate new ideas, separated from their previous ideas (worksheet). For example, participant 4 wrote his reflection that "*The stimuli heavily inspired me. I also came up with different products from scratch that are inspired by the product provided as an example. This was interesting to me because it showed that navigating through an already present option may be the way to develop a new and original one even though it's heavily influenced by the first. After using the stimuli's features and functionalities as a reference for inspiration, I came up with several refined ideas. The first idea was to create a soft toy attached with interactive features such as the ability to sing soothing lullabies to help comfort the child. My second idea was a speaker that plays sounds and interacts with the child in a certain sequence to create a specific routine to help the child sleep more easily*." **Second,** they have a chance to incorporate features provided by text stimulus into their initial ideas, which is a more common behavior in their reflection. Participant 10 recorded the ideation process after being exposed to the text stimulus that "*From the 'Interactive features' part of the slides, I came to my first idea (from left) to add a learning algorithm to the product so it can learn from the baby's behavior what images and songs make the baby sleep better and always use that material to make the baby sleep. In the second idea, I improved my pillow product from the previous part based on the answers of the AI*." Participant 19 also expressed how he refined his original ideas to produce more advanced and improved ideas.

Among the remaining three participants, one expressed their views on Generative AI and text stimulus, specifically highlighting the emphasis on technology in the produced thoughts after the stimuli. Another participant said, "*The stimuli were ineffective as most of the ideas were already documented on the paper*." A single participant had an unfavorable opinion of Generative AI, stating, "*even though this product- DreamGuard Buddy sounds promising, the features and functionalities suggested are disconnected and too broad*."

As discussed in previous paragraphs, combining the results from their best ideas that 16 participants inspired and combined text stimulus in their best ideas, and the reflection from their documentation (more than half of effective documentation reported positive influence by text stimulus), we summarized that *Generative AI could assist students in ideating their ideas, such as providing a new idea and developing new functions of their ideas.*

6. Conclusion

Due to the rise of AI technology, many researchers have identified that Generative AI might be applied to ideation for creativity enhancement. Following this inquiry, we conducted this experiment to investigate how text stimulus generated by Generative AI influences students in ideation and whether Generative AI assists students in ideation. This study was carried out in a creative design course with 26 participants, and more than half of them showed or reported they obtained benefits from the text stimulus (Generative AI generated). The results showed that Generative AI could assist students in ideation from two perspectives, helping them to generate new ideas that are different from the initial ideas they generated, and assisting them to develop their initial ideas by providing new features.

Our research has several limitations. Initially, the present investigation was carried out in a real-life exercise scenario, implying that it was not done under controlled laboratory conditions and might potentially be affected by many external influences. The present study is constrained by the limited number of participants and the sequence of ideation. Furthermore, as our pilot investigation, we did not measure the participants' ideas in terms of originality or practicality, which might be a potential avenue for future investigation. Furthermore, we only used textual stimuli created by Generative AI, without explicitly prompting participants to utilize Generative AI systems like ChatGPT interactively. The reason for this is because our intention was to investigate the impact of basic inspiration and stimulation, rather than delving into the intricate operations of Generative AI models. It is important to note that such models may occasionally display hallucinations or fixations. Additionally, these models are often trained on biased data sets and lack of technical specificity, which can restrict their potential applications during the early stages of development.

The current study has implications for design research. First, we verified students could benefit from Generative AI that could assist them to develop their ideas, which might inspire other researchers to further explore the utilization of Generative AI in the design process, such as ideation. Second, students hold a positive attitude towards integrating Generative AI in their outputs and believe that Generative AI assisted them in ideation. Third, while AI technology presents challenges and ethical issues for design education (Tahiru, 2021), it also provides opportunities and benefits. We could investigate the fundamentals of using AI in education and how to benefit from it rather than avoid it.

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