Integrating AI into Design Ideation: Assessing ChatGPT’s Role in Human-Centered Design Education

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Abstract

This study investigates the impact of ChatGPT as a collaborative tool in the ideation phase of human-centered design processes, involving 208 students across 37 groups. Through analysing student reports and reflections, both with and without ChatGPT usage, the study explores its impact on creative processes and its educational value. Our findings indicate that ChatGPT contributes significantly to enhancing the overall quality of creative projects and aids in problem identification, offering students broader perspectives. However, its contribution to enhancing creativity, feasibility and effectiveness of solutions was found to be marginal. We highlight the challenges of integrating ChatGPT in group work, particularly regarding its influence on group dynamics and creativity. This study highlights the need for more structured guidance on effectively using ChatGPT, balanced with encouraging student-led experimentation with the tool. We contribute insights into the nuanced application of AI tools like ChatGPT in educational contexts, especially in facilitating collaborative design tasks.
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Keywords: Artificial Intelligence, AI in Education, AI in Group Learning, ChatGPT and Creativity, Generative AI, Human-AI Interaction in Education

1 Introduction

The rapid advancements in Large Language Models (LLMs), particularly OpenAI’s ChatGPT, have sparked a blend of excitement, scepticism, and novel research opportunities in education [Rahman and Watanobe, 2023], [Grassini, 2023], [Rudolph et al., 2023]. Widespread concerns about the misuse of Chat Generative Pre-trained Transformer (ChatGPT) in educational settings lead to prohibitions and restrictions in various institutions worldwide [Chan and Hu, 2023], [Yu, 2023]. However, others argue that it is essential to teach students how to use tools like ChatGPT to prepare them with essential competencies for a rapidly changing society [Zhai, 2022] and ensure they are equipped to use such technologies effectively in their future careers [Terwiesch, 2023]. The integration of GPT in education should emphasise effective usage and understanding of the development behind these technologies [Elbanna and Armstrong, 2023].
While there is significant interest in using ChatGPT in creative fields, empirical understanding of its role as a tool—or even team member—for facilitating creativity in group learning contexts remains sparse. Discussions often focus on its capacity for individual, personalised, and adaptive learning (Kasneci et al. [2023]), yet how it functions in collaborative settings is underexplored. In early design stages, the variety and diversity of conceptual designs are crucial for innovation (Zhu and Luo [2022], Daly et al. [2012], Liu et al. [2002], Brophy [2001]), yet designers often face fixation on existing features, limiting novel idea generation (Viswanathan et al. [2016]). Traditional methods like brainstorming (Osborn [1953], Wilson [2006]), analogical thinking (Perkins [1997]), and design heuristics (Yilmaz et al. [2016], Daly et al. [2012]) are developed to remedy design fixation and promoting out-of-the-box thinking (McFadzean [1998], White et al. [2012], Yilmaz et al. [2016]). In addition, limitations in designers’ knowledge can exacerbate the challenge of design fixation (Zhu and Luo [2022]), a gap where ChatGPT can potentially step in to offer supplementary information. Moreover, ChatGPT’s ability to generate diverse and unconventional ideas, even straying from strict factual accuracy, can be advantageous (Taveekitworachai and Thawanmas [2023]).

This paper explores ChatGPT’s role in a human-centered design (HCD) course, focusing on its impact on group dynamics and creativity, aiming to identify best practices for its integration into educational settings. Through the analysis of student reflections, this research examines ChatGPT’s capabilities and collaborative impact. Findings indicate a general enhancement in project quality, though the effect on creativity is marginal and not statistically significant.

2 Related Work

Several studies have scrutinised ChatGPT-3.5’s abilities in different educational contexts, including Law, Medicine, and Mathematics, revealing performances that span from below average to moderately satisfactory (Lo [2023], Choi et al. [2021], Kung et al. [2023], Frieder et al. [2023]). However, advancements with GPT-4 show considerable improvement, evidenced by its top 10% performance in a simulated American Bar Exam, significantly surpassing GPT-3.5’s lower rankings (Savelka et al. [2023], Achiam et al. [2023]). Related literature predominantly includes assessments of LLMs in exams (Feng et al. [2024], Gilson et al. [2023], Rosoł et al. [2023]), opinion papers (Yu [2023], Kasneci et al. [2023]), and reviews (Elbanna and Armstrong [2023], Lo [2023], Baidoo-Anu and Anshah [2023]). Empirical research on the impact of LLMs in educational settings is relatively scarce with few notable exceptions (e.g., Chan and Hu [2023], Phung et al. [2023], Prather et al. [2023]); however, many of those focus on teachers or institutional perspectives (e.g., Bucea-Manca-Yonis et al. [2022], Polak et al. [2022], Kyrakova and Angelova [2023]) rather than students.

In the realm of creativity and group work in HCD, only a few studies explore ChatGPT’s role. Verheijden and Funk [2023] developed BrainFax, a visual co-creation tool that uses Stable Diffusion for image generation integrated with a chatbot and online whiteboard. Their findings suggest that it can boost creativity but requires thoughtful workflow integration. Zhu & Luo [2022] developed a fine-tuned LLM based on patent data to aid creative design ideation by allowing the retrieval of near or far-domain stimuli to aid creative design ideation. Kulkarni et al. [2023] explored the impact of generative Text-To-Image models on the design processes among non-professional designers, particularly in collaborative settings. They found that such models can help participants explore a design space rapidly and enhance fluidity in collaborative efforts. Epstein et al. [2022] utilised generative AI to facilitate collaborative speculation on future utopias, finding that the divergence between participants’ expectations and AI-generated images sparked new insights and lateral thinking for creative ideation.

3 Study

This research was conducted in the context of a first-semester introductory Human-Centered Design (HCD) course at the university [removed for blind review]. The course curriculum introduced first-semester students to HCD’s core principles, stages, and methods. In addition, students engaged in a semester-long group project that paralleled the lectures, evolving through iterative stages. Initially, participants selected one of the three suggested thematic areas (i.e., exercise, connectedness, or recycling) and identified a specific problem within it for exploration. Student groups navigated through problem identification, ideation, prototyping, and evaluation stages as the semester progressed. At the end of each stage, students had to submit a mandatory progress report and receive feedback from the teaching staff before progressing to the next stage of the HCD process.
For the first time this year, in fall 2023, the curriculum incorporated a new module focused on incorporating ChatGPT into the ideation process. During this module, the students were introduced to foundational concepts and functionalities of large language models (LLMs), coupled with a discussion on their potential advantages and limitations. Subsequently, the module revisited various ideation techniques covered earlier in the course (e.g. brainstorming, HMW questions, six thinking hats, competitive analysis, and free association), aiming to showcase how ChatGPT could act as an additional group member during the ideation phase. It was made clear that using ChatGPT for their project was not mandatory and that those examples were only suggestions allowing students the autonomy to experiment with ChatGPT’s integration into their workflow as they deemed fit. However, they had been instructed that each group was expected to critically reflect on their engagement with ChatGPT in their progress reports, detailing its utility or hindrance in the ideation process, its impact on team dynamics, and their rationale for opting in or out of its usage.

Typically, studies that assess the effectiveness of tools or methods to support the creative process opt for split-sample research designs (e.g., Daly et al. [2016], Chulvi et al. [2013]). We adopted a more integrated, comparative approach due to educational and methodological considerations. All students enrolled in the fall 2023 semester were exposed to ChatGPT as a novel curriculum component. This enabled us to directly compare their project outcomes with those from the fall 2022 cohort, who completed the course without ChatGPT exposure, considering that the early demo of ChatGPT was released on November 30, 2022. This strategy ensured that every student received a consistent educational experience while allowing us to isolate and evaluate the impact of ChatGPT on the creative process. By maintaining uniformity in course content, structure, and teaching methods across both years, the study was uniquely positioned to attribute any observed differences in project quality and creativity directly to the introduction of ChatGPT, providing a focused analysis of its effectiveness as a collaborative tool in educational settings.

3.1 Participants

The participant cohort consisted of 208 first-year students enrolled in an introductory HCD course during the fall semester of 2023. The students originated from eight distinct academic disciplines and formed 41 project groups. The disciplines with the highest enrollment included bachelor’s programs in Programming (n=68), Web Development (n=55), Interaction Design (n=33), and Graphic Design (n=31). Each project group comprised of 4–6 members and was assembled randomly to ensure an interdisciplinary mix, fostering diversity of thought and approach within each team. For comparative analysis, data from the fall semester of 2022, which included 180 students organised into 37 groups from the same disciplines, was used as a baseline.

3.2 Procedure

An independent research assistant, uninvolved in the subsequent evaluation process, prepared the study reports for an anonymous review. This preparation involved the removal of any identifiable details, including all mentions and reflections related to ChatGPT usage. Additionally, the reports were arranged in a random sequence. The objective of these modifications was to eliminate any clues that could potentially reveal to the evaluators the specific year of each report or whether ChatGPT had been utilized in the study. These anonymised and randomised report sequences were then utilised in the subsequent evaluation by a panel of domain-relevant educators.

3.3 Report evaluation

Considering that we aimed to assess the student reports on several quality dimensions as objectively as possible, we opted to perform a trained panel evaluation based on Papachristos et al. [2021]. The goal of the trained panel method is first to reach a consensus among trained experts on the definitions of evaluative dimensions and then to create a profile of several artefacts based on this consensus. We recruited five university teachers (assistant and associate professors) who had previous involvement in teaching HCD. Three of them were study-program leaders in three areas of education (interaction, web, and graphic design), and the other two were educators with more than ten years of experience teaching HCD. We aimed for a group of participants who are experienced in teaching HCD but also have diverse backgrounds to consider all possible aspects of report qualities while selecting and defining evaluative dimensions. The evaluation of the reports was completed over the course of three days, spanning three separate six-hour sessions.

3.4 Data Analysis

Following the evaluation by the trained panel, the research assistant who initially prepared the data revealed which reports were written supported by ChatGPT and which were not. We calculated average ratings from the five evaluators and then divided the data into two groups based on whether ChatGPT was used. This categorised data was then analysed to compare performance across six evaluative dimensions identified in the panel evaluation. These dimensions were
the **Overall Goodness** assessing the report quality, evaluation of the novelty versus derivativeness of the **Problem Identification**, the quality of the proposed **Design Concepts**, the **Creativity** of the designs, the **Feasibility** of the design proposals, and finally, the **Effectiveness** of the design concepts in addressing the students’ proposed problem statements.

In the second phase of our analysis, we investigated varying participant perceptions of ChatGPT’s effectiveness in the ideation phase of HCD. Following Braun and Clarke’s reflexive thematic analysis [Braun and Clarke 2019, Clarke and Braun 2017], our study interprets patterns of shared meaning in the perceptions of ChatGPT’s role during ideation. We base our analysis on student reflections about ChatGPT’s usage from their reports. We followed an inductive coding approach applied iteratively, using a shared digital notebook for collaborative analysis. While our examination encompasses all aspects of the reports, we paid particular attention to the designated subsection, ‘Reflection about ChatGPT usage.’ We next present the four primary interpretive themes identified: 1) Utility in Ideation, 2) Impact on Group Dynamics and Creativity, 3) Learning and Skill Development, and 4) Challenges and Limitations of AI in Creativity.

## 4 Results

This section outlines our quantitative analysis of ChatGPT’s influence on ideation quality, measured against the six evaluative dimensions established during the trained panel session. Subsequently, we present the results of our thematic analysis, which provides insights into student perspectives of ChatGPT’s role as a team member in the ideation process.

### 4.1 Impact of ChatGPT on Ideation

The comparison of the reports showed slightly better performance with ChatGPT help on all evaluation dimensions apart from Feasibility (see Figure 1). However, differences were statistically significant only for the Overall Goodness ($t(76) = 2.294, p < .025, g = 0.52$) and Problem Identification ($t(71.7) = 2.171, p < .033, g = 0.49$) dimensions. On average, reports from the ChatGPT member group received higher Overall Goodness evaluations ($M = 4.33$, $SD = 1.36$) compared to those without ($M = 3.65$, $SD = 1.24$). Results also showed that Problem Identification was more novel and less derivative in groups using ChatGPT ($M = 4.77$, $SD = 1.69$) than without ($M = 4.77$, $SD = 1.69$). The effect size was calculated using Hedges’ $g$ (appropriate with different sample sizes) and showed that in both findings, the effect size was on the border of small and medium (i.e., .52 and .49). These findings suggest a modest enhancement in report quality from a summative standpoint, offering valuable insights but not fully capturing the complexities of incorporating ChatGPT in group ideation. The next step was to examine student reflections to gain a more comprehensive understanding and complement our analysis.
4.2 Reflections about ChatGPT in Ideation

The examination of the reports revealed a variety of approaches to using ChatGPT for ideation. Groups used ChatGPT to perform many of the methods and techniques taught in the course, including Crazy-8, 6-thinking hats, and brainwriting, as well as to create personas and pilot test questionnaires. Many of the approaches were novel and resulted in interesting reflections. The following sections detail the results of our reflexive thematic analysis, structured around the themes we identified.

4.2.1 ChatGPT’s Utility in Ideation

Several groups input their problem statements into ChatGPT, seeking its assistance in ideation, which resulted in a diverse range of experiences and reflections. Some groups found ChatGPT’s input beneficial, as it offered new perspectives and challenged existing viewpoints. This was perceived as particularly useful if they experienced creative stagnation or dissatisfaction with their brainstorming results. One student stated, “It provides us with new perspectives and viewpoints that challenge our own thoughts, leading to deeper insights” [G25]. However, a common observation among the students was that ChatGPT’s suggestions often mirrored their own ideas and lacked creativity. This sentiment is articulated well by G13, who stated that: “Despite numerous iterations and additional specifications, the ideas it produced were largely familiar solutions, falling short of inspiring us as intended” [G13] and “…the ChatGPT answers we got were good, but not revolutionary” [G2]. Interestingly, some groups viewed the alignment of ChatGPT’s suggestions with their own as a positive affirmation of their creative direction, with one saying, “When our solutions matched with some of ChatGPT’s suggestions, we became more confident that our solutions were good” [G11]. However, other groups reported dissatisfaction with ChatGPT’s effectiveness in ideation, with one group reporting that, “Our experience with ChatGPT’s output confirmed that we consistently receive the same results with our own brainstorming, which is why we refrain from using it further” [G9]. The groups that reported a more positive experience with ChatGPT in the ideation process were those who engaged more creatively with the tool. One of these participants stated, “So, it took some encouragement, and feeding the prompt with more outlandish ideas, to push ChatGPT to think outside the box and make it avoid easy solutions” [G35]. Additionally, groups found value in utilising ChatGPT for tasks other than directly generating ideas, such as refining problem statements. G18 reported that “We requested ChatGPT to generate diverse problem statements. [...] we could consolidate all these initial statements into a compact and comprehensive sentence that ultimately formed our final problem statement” [G18].

4.2.2 Impact on Group Dynamics and Creativity

Students were encouraged to experiment with ChatGPT as an additional group member, leading to varied outcomes. Some groups successfully integrated ChatGPT, enhancing their dynamics and ideation process. They expressed their opinions in this vein, such as, “ChatGPT was used only to assist the group and was not used as a replacement. This way, it worked as a sixth group member” [G30], and “ChatGPT made us have more group discussions; it also helped us generate more ideas and better flesh out those we already had” [G40]. Instead of having ChatGPT directly tell them solutions, some groups incorporated it into their process: “We would ask a general question and use the responses we got as the starting point of our discussion. We do not think it affected the amount of group discussions. If anything, it probably helped kickstart our own creativity” [G8]. However, some groups found it challenging to incorporate ChatGPT into their groups: “…ChatGPT is a better tool than group member as any communication with it breaks up the flow of conversation, ideation, and discussion and shifts focus to whatever response ChatGPT comes up with” [G17]. Some made interesting observations about how using ChatGPT in ideation affected group dynamics, with one stating, “We also noticed that we made ChatGPT a leader, not a group member. If we had used AI from the start, this would have made the group less self-sufficient and creative. If we continue to use ChatGPT as a group member, we would need more information on how to phrase our questions and ask good follow-up questions” [G29].

4.2.3 Learning and Skill Development

Despite its ease of use, a key theme identified was the necessity for skill development in effectively utilising ChatGPT. Students recognised that there is some skill involved in getting more out of using it in ideation: “Our use of ChatGPT was fairly surface level... to use it for more in-depth tasks, we would likely need more information on how to do this” [G8]. The proficiency in crafting prompts emerged as crucial, with several groups acknowledging the need to refine their questioning techniques: “...we would need more information on how to phrase our questions and ask good follow-up questions” [G29] and recognising the challenge in formulating effective inquiries: “using AI to generate ideas is to ask the correct questions. If we did not formulate our questions well enough, we did not get back any useful answers. This is tricky and requires multiple tries” [G34]. Beyond just prompting, groups sought guidance on strategically incorporating ChatGPT into their ideation processes for more inventive outcomes: “To maximise the utility of ChatGPT, a more strategic approach to its use would be useful... more information on its integration into the ideation
and problem-solving process could lead to more creative outcomes” [G29]. Additionally, the careful integration of ChatGPT within educational systems was highlighted, considering concerns like plagiarism and misinformation: “The use of AI learning modules in school is a bit of a touchy subject... but we feel we have a relatively good understanding of how to use ChatGPT with fair use” [G40].

4.2.4 Challenges and Limitations of AI in Creativity

The integration of ChatGPT in the creative process presents a range of challenges and limitations, particularly in terms of novelty and the process of ideation. Regarding learning, students emphasised the value of traditional methods in the learning process before introducing AI. One group pointed out, “...to gain the most learning outcome, it is quite important to let the group generate ideas using the methods learned in class before using ChatGPT” [G30], while another observed, “...had we used it in the beginning, we would most likely not have learned the different techniques used in each step of the way so thoroughly” [G23].

Concerns were also raised about the novelty of ideas generated by ChatGPT. A student remarked, “It became evident that ChatGPT excels at affirming existing ideas but struggles when generating entirely novel concepts” [G13]. This limitation is attributed to how ChatGPT has been trained: “AI is trained on already existing data, so it is hard to know if what you are getting really is an original idea or not” [G14]. Further, it was noted that “The program itself is not creative; it just presents ideas based on the work of others” [G37]. However, a common notion among the reflections was that the effectiveness of ChatGPT in creative teamwork depends on how it is utilised: “The effect is entirely based on how the group uses it, the same as any other tool” [G8]. Groups also discussed the importance of being critical of ChatGPT’s suggestions: “If we just took the answer it gave without employing critical thinking, then it would certainly undermine the effectiveness of our teamwork” [G3]. Solutions presented for this emphasised the need for a balanced approach: “As long as it is used sparingly and for specific issues rather than an overall solution, we believe its strengths outweigh its weaknesses” [G3]. These reflections highlight the need for a deeper understanding of ChatGPT’s capabilities and limitations for optimal integration into the ideation and problem-solving processes. Finally, students noted the tool’s limitations compared to human capabilities, including a lack of creativity, emotional intelligence, and context understanding. They emphasised that ChatGPT can be a valuable tool in specific contexts, but human insight remains indispensable, highlighting their belief that, for now, AI cannot replace real human interaction and creativity.

5 Discussion

Our findings indicate that while ChatGPT usage improved the overall quality of student reports, its impact on enhancing design concepts and creativity was minimal and not statistically significant. This observation aligns with student reflections, where many groups expressed a lack of enthusiasm for ChatGPT’s suggestions. Common feedback included perceptions that ChatGPT often reiterated ideas the groups had already considered. This was particularly evident among groups directly feeding their problem statements into ChatGPT and seeking immediate design solutions. Similarly to Verheijden et al., Verheijden and Funk [2023], who explored Text-to-Image models for group ideation, our results show less optimal ideation in result-oriented approaches than in process-oriented ones. Directly asking ChatGPT for solutions had a less positive impact on creativity and group work compared to using it incrementally throughout their ideation workflow. Groups that employed ChatGPT in more nuanced ways, engaging in brainstorming sessions, applying different ideation techniques, and revisiting and refining their problem statements, reported more favourable outcomes. This approach correlates with the statistically significant improvement in problem identification observed between 2022 and 2023 course iterations (see Figure 1). These findings align with emerging research suggesting that LLMs like ChatGPT can be effectively utilised in identifying research gaps and formulating hypotheses [Dahmen et al. 2023, Karakose 2023].

The perceived lack of originality in ChatGPT’s responses was frequently attributed to its training on pre-existing data. Students’ fears that they were not really innovating by following ChatGPT suggestions are in alignment with broader concerns about the possibility of idea homogenisation due to over-reliance on AI [Kirk et al. 2023, Tokayev 2023, AlAfnan et al. 2023]. Furthermore, while the literature suggests that AI-assisted decision-making might improve accuracy in the short term, it also cautions against a potential drift toward content uniformity and diminishing unique ideas over time [Fügener et al. 2021, Nakadai et al. 2023]. The strategic use of ChatGPT, focusing on refining the framing of problems rather than generating direct solutions, could enhance the creative process, leading to more substantial contributions in the ideation phase. Some educators recognise the potential of ChatGPT to enhance critical thinking and creativity within teaching practices [Kiryakova and Angelova 2023]. However, it is crucial to be strategic about how to introduce ChatGPT in learning activities to avoid stifling students’ creative development [Niloy et al. 2023] and to avoid reducing their learning opportunities.
Aligned with observations by Kulkarni et al.\textsuperscript{[2023]} and Suh et al.\textsuperscript{[2021]}, our research also suggests that generative AI, like ChatGPT, can positively influence group dynamics in creative teamwork. Numerous groups reported that it stimulated engaging discussions and inspired collective creativity, while some found the experience also to be fun. However, others were more cautious, mentioning the need for mindful engagement and carefully considering when and how to interact with ChatGPT to ensure it augments rather than dominates group discussions.

The student reflections conveyed cautious optimism about the educational benefits of utilising ChatGPT. Numerous groups reported effective use of ChatGPT to acquire knowledge about various methods, concepts, and techniques. Similar to other studies Verheijden and Funk\textsuperscript{[2023]}, a recurring theme was the desire for enhanced guidance on effective, prompt formulation. Interestingly, several students highlighted the importance of strategic timing in incorporating ChatGPT into their learning process. They saw value in mastering ideation techniques independently before integrating ChatGPT. This highlights the need for more research about when and how to incorporate AI tools into the workflow of creative groups. Several key observations emerged during the evaluation of the decision to encourage students to use and experiment with ChatGPT in the course. Primarily, students valued the trust placed in them to decide how to integrate ChatGPT autonomously into their learning, as opposed to outright prohibition and prescriptive guidelines. This approach resonated with the students, reflecting the educators’ concerns about the risks of over-dependence on ChatGPT Qadir\textsuperscript{[2023]}, Mogavi et al.\textsuperscript{[2024]}, Lin\textsuperscript{[2023]}. The reflections exhibited a mature approach, with students engaging in meta-learning processes. They critically assessed and scrutinised the outcomes from ChatGPT, demonstrating an ability to evaluate their learning and the tool’s effectiveness independently.

5.1 Limitations and future work

A limitation of this study arises from the semi-controlled nature of the comparative analysis between the course’s 2022 and 2023 iterations. While both iterations shared the same learning context and materials, the lack of a fully controlled experimental setting may have allowed for potential confounding factors to influence the results. Nonetheless, the consistency observed in student reflections, which corroborate the main findings of the comparison, suggests a moderate positive impact of ChatGPT on learning outcomes. This alignment adds confidence to the results despite the acknowledged limitations in the study’s design. Based on our findings, future work should focus on developing guidelines for strategic AI usage during ideation while allowing room for students’ freedom of experimentation. Such research would aim to enhance the creative process within educational frameworks and nurture the growth of critical thinking and problem-solving abilities.

6 Conclusion

This study provides insights into the role of ChatGPT in an educational context, specifically during the human-centred design ideation process. While ChatGPT offered valuable assistance with measurable improvements in student reports, it also revealed limitations in generating novel concepts. The effectiveness of ChatGPT as a collaborative tool was highly dependent on how it was utilised within the group, emphasising the importance of strategic use and critical engagement with AI-generated suggestions. Students highlighted the need to balance traditional ideation methods and AI assistance to foster creativity and maintain dynamic group interactions. This study underscores the potential of AI tools like ChatGPT in educational settings but also advocates for AI’s more informed and selective application in ideation, ensuring that these tools complement rather than overshadow human-led creative processes.

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