

How does the integration of generative AI (LLMs) influence human creativity in idea-generation processes, specifically within innovation workshops?

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April 15, 2025

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Abstract

The growing use of generative artificial intelligence (AI), particularly large language models (LLMs), raises critical questions about their role in enhancing or constraining human creativity. This paper explores how LLMs influence creativity in structured idea-generation processes, specifically within innovation workshops. Based on a thorough review of existing research, the study defines creativity as the generation of ideas that are both novel and useful and investigates how LLMs impact this process cognitively, socially and also practically.

These findings suggest that LLMs support the divergent phase of creativity by offering new stimuli, greater ideation fluency and lowering cognitive barriers such as fixation and bias. In collaborative settings, they act as neutral contributors, helping participation and provoking unexpected directions. However, the use of LLMs also presents risks, including superficial novelty, idea convergence and passive subjection on machine-generated content. Their lack of contextual understanding and assessment capacity further limits their role in convergent thinking phases.

The paper argues that the effectiveness of LLMs in innovation workshops depends on clear framing, thoughtful prompting and especially active human engagement. LLMs are most valuable for every work, when integrated as co-creative tools that provoke reflection and discussion rather than dictate content. To achieve this potential, innovation processes must be intentionally designed to balance the speed and range of AI output with the depth and contextual awareness of human input.

Keywords: Generative AI, Large Language Models, Creativity, Idea Generation, Innovation Workshops, Human-AI Collaboration

1 Introduction

Generative artificial intelligence (AI), particularly large language models (LLMs) such as ChatGPT, currently stands at the leading position of technological innovation and academic discourse. These AI systems have demonstrated extraordinary capabilities in generating coherent, human-like text and managing complex dialogues, revolutionizing tasks ranging from educational assistance and content creation to customer service interactions and creative problem-solving [7, p. 1-2] [18, p. 1-2]. Despite their impressive performance, these models operate primarily through statistical associations rather than genuine semantic understanding, which raises critical questions about the nature and authenticity of their "creativity" [7, p. 1-2].

A particularly intriguing application of LLMs lies in their potential to support human creativity, specifically within the context of idea generation in innovation workshops. Traditionally, creativity in such workshops involves generating ideas that are both novel and practically valuable. According to widely accepted definitions, true creativity must encompass originality and effectiveness, which means that the ideas generated must be not only unique but also applicable and beneficial [17, p. 92]. Innovation, in turn, relates closely to creativity, defined by the practical realization and implementation of these creative ideas into valuable outcomes.

Given the broad conceptual scope of creativity and innovation, this paper explicitly narrows its focus to the context of structured idea-generation processes within innovation workshops. Creativity, for the purposes of this research, will therefore specifically refer to the generation of novel, applicable and valuable ideas by individuals or teams within these structured innovation settings [17, p. 92-93]. By clearly giving this definition, the research aims to provide a precise examination of how generative AI might influence human-driven creative processes.

The integration of LLMs into structured creative processes poses both opportunities and challenges. On the one hand, these systems may significantly augment human creativity by rapidly offering diverse perspectives, unexpected analogies and novel combinations of existing knowledge, thus overcoming typical cognitive barriers such as limited cognitive load or confirmation biases [8, p. 703] [13, p. 2-3]. In contrast, critical voices argue that while AI-generated content might appear in a superficial way innovative, it often lacks true originality or deeper semantic coherence, leading to outputs that are novel, yet ultimately limited in genuine creative depth [7, p. 3] [13, p. 2].

Consequently, this study explores the implications and practicality of integrating generative AI within innovation workshops, examining whether

such integration genuinely enhances human creativity or merely produces superficial novelty. The research critically assesses the potential of AI-based tools to enrich structured idea-generation processes, providing insights into whether these tools can effectively support or even amplify human innovation capabilities [13, p. 2-3].

1.1 Research Question

This research specifically investigates the following question: How does the integration of generative AI, particularly large language models (LLMs), influence human creativity in idea-generation processes within innovation workshops? By addressing this question, the study aims to clarify the practical role of LLMs and their impact on the originality, applicability and overall quality of ideas generated collaboratively between humans and AI systems. Additionally, the research seeks to identify whether LLMs primarily serve as enhancers, providing novel insights that inspire human creativity or if they potentially restrict deeper, more meaningful creative thinking by introducing superficial novelty.

1.2 Research Method

To systematically address this question, the paper conducts a structured literature review. Key academic and practical sources on creativity, idea generation, innovation workshops and generative AI, especially LLMs, are critically analyzed. This method allows for a balanced overview, highlighting both agreement and disagreement among scholars, while clearly identifying areas that require further investigation. Through this comprehensive approach, the study aims to clarify existing theoretical perspectives and provide a solid foundation for understanding how generative AI influences human creativity in structured innovation processes.

2 Theoretical Background

2.1 Defining Creativity and Innovation in the Context of LLMs

Creativity is a diverse concept, often debated across fields such as psychology, business and philosophy. However, a widely accepted definition emphasizes that creativity involves the production of ideas that are both original and useful [17, p. 92]. Originality ensures novelty, while usefulness relates to the practical application of the idea. These two criteria are fundamental for distinguishing creativity from simply novelty or random ideation.

Innovation, though closely related to creativity, is generally understood as the successful implementation of creative ideas in a way that brings value [17, p. 92–93] [9, p. 6]. While creativity generates potential, innovation realizes it in real-world scenarios. In business and organizational settings, innovation often requires systematic approaches and resources to turn abstract ideas into concrete outcomes [4, p. 198].

In the context of innovation workshops, creativity takes a specific and focused form: idea generation. These workshops are typically structured settings where individuals or teams are tasked with producing as many relevant and feasible ideas as possible in response to a defined goal [2, p. 2–3]. The creative process is thus embedded within collaborative problem-solving activities, often supported by moderators, prompts and increasingly, digital tools.

This paper focuses on this structured form of creativity, idea generation, as it is also likely the most relevant phase where LLMs can be integrated. Unlike artistic creativity or long-term innovation development, idea generation lends itself to measurable outputs and allows for controlled observation of AI influence. Furthermore, structured ideation enables better evaluation of how LLMs impact not just quantity, but also the quality and originality of ideas [13, p- 4–5] [8, p. 703].

Understanding creativity as a process also opens the door to methodological interventions. Creativity is not seen as a static feature, but rather as something that can be nurtured, guided and reinforced. This process-oriented view aligns with knowledge creation theories, which state that new knowledge emerges from the dynamic interaction of existing information, context and tools [9, p. 5]. LLMs, as language-based tools, can thus play a role in easing such interactions.

Therefore, the relevance of LLMs in this context depends not only on whether they can be creative themselves but also that they can enhance human creative processes, especially in structured idea generation scenarios,

such as innovation workshops. This sets the foundation for the following sections, which examine how LLMs function, influence creativity and are used in practical settings.

2.2 How LLMs Function and their Relevancy for Creative Work

Large language models (LLMs) such as GPT-4 are based on transformer architectures and are trained on an extensive corpora of text data to predict the most likely continuation of a given sequence. Their functionality relies on next-token prediction, statistical modeling and attention mechanisms that allow them to generate fluent and also context-aware responses. Even though they do not understand content in a human-like way, they are still capable of imitating language patterns across a wide range of areas [1, p. 4].

Their relevance for creative work lies in the fact that creative thinking, especially in its divergent phase, involves the recombination of already existing knowledge in new ways that bring out something new. LLMs are highly effective in not only retrieving and recombining linguistic elements, but also in often producing surprising or completely novel outputs [18, p. 2]. This makes them especially useful in contexts where radical steps and varied inputs are beneficial, such as brainstorming or conceptual exploration.

However, LLMs also issue clear limitations. One of the most discussed is the phenomenon of "hallucinations", where the model generates plausible-sounding but incorrect and even misleading content [13, p. 2]. In conventional applications, such as legal or medical settings, this presents a serious problem. But in creative settings, where usefulness is not always immediate or needs to be factual accurate, such unpredictability can instead be an asset [14, p. 5].

Moreover, LLMs lack intentionality and contextual awareness. They do not possess goals, preferences or understanding, which differs their outputs from those of humans [7, p. 2]. Nonetheless, when properly guided through effective prompting, they can serve as an amplifier for new ideas, offering new and diverse starting points or even challenging assumptions through unexpected associations [13, p. 3].

In this light, LLMs should be looked at less as autonomous idea generators and more as tools that can augment human ideation. Their value comes from their ability to externalize language-based thought processes and offer a form of creative stimulation or a cognitive framework [14, p. 3]. This potential will be further explored in the following section by taking a closer look at how LLMs actually influence human creativity in practice.

3 Results

3.1 How LLMs Influence Human Creativity

Several recent studies offer information on how LLMs impact human creativity during ideation tasks. Kumar et al. (2024) conducted randomized experiments comparing collaborative settings of human only and AI-human. They suggested in this study a reduction in cognitive load from participants during divergent thinking tasks when receiving ideas directly from LLMs, compared to receiving strategic guidance alone [10, p. 3–4]. Similarly, Meincke et al. (2024) showed that ideas produced with the support of LLM often scored higher in average purchase intent, although they were rated lower in perceived novelty [13, p. 4]. These findings point to a trade-off: AI assistance can boost efficiency and feasibility but may narrow the creative range of ideas.

In a broader comparison of idea quality, Castelo et al. (2024) reported that GPT-based systems were more likely to produce top-performing ideas in view of marketability. Their analysis showed that LLMs generated a higher share of high-ranking ideas than human participants when judged by external evaluators [3, p. 7–8, 18–20]. However, they also noted a tendency toward repetition and thematic similarity in AI-generated content, raising concerns about idea diversity and range.

Divergent and convergent thinking are the key processes in creativity and are affected differently, when supported by LLM. While divergence (idea generation) can be enhanced through stimulus variety and idea quantity, convergence (idea refinement and selection) requires critical evaluation and contextual understanding [10, p. 3–4] [6, p. 3]. Studies indicate that LLMs perform better in supporting divergence, because they offer a broad range of possible responses, but their usefulness in convergent phases depends heavily on human interpretation and selection [10, p. 5].

Prompting strategies also play a crucial role in shaping the quality of AI-supported creativity. Meincke et al. (2024) found that few-shot prompting, which provides examples for possible outcomes before asking the model to generate output, led to more targeted and higher-rated ideas than zero-shot prompting, which provides no examples ahead of the output [13, p. 5]. Lu et al. (2024) also emphasized the potential of role-based prompting and discussion frameworks to enhance the creative capacity of LLMs [11, p. 2–5]. These methods simulate group dialogue and introduce constraints that guide the model toward more varied and meaningful responses.

Overall, while LLMs can facilitate idea generation and support human creativity in measurable ways, their effectiveness depends on careful integra-

tion. The design of the human-AI interaction, including prompt structure and task framing, plays a decisive role in determining whether AI input enhances or limits the creative process.

3.2 Cognitive and Social Aspects of Human-AI Co-Creation

The integration of LLMs in creative settings can not only affect the cognitive dimensions of the ideation process but can also reshape the social dynamics of work in group settings. On the cognitive level, LLMs can help reduce mental load and support individuals in overcoming common barriers to creativity. These include cognitive biases, such as fixation on already familiar ideas and the limited ability to explore diverse conceptual thoughts under time pressure [8, p. 703] [15, p. 253–254]. By acting as external stimuli, LLMs can disrupt conventional thinking patterns and introduce new unexpected directions for idea development.

Marrone et al. (2024) argue that narrow AI can help stimulate human creativity by offering associative suggestions that can broaden the user’s mental search space [12, p. 6–7]. Rather than replacing human ideation, AI acts as a cognitive support that amplifies the user’s internal process. When participants are stuck in their thinking, the model’s output can serve as a launching pad and unlock new directions and break through blockades in their thought-process. Importantly, this cognitive support is not uniform and depends strongly on how well the AI input is critically assessed, understood and then integrated by the user.

Beyond the individual level, LLMs influence the group dynamics of innovation workshops. In brainstorming or co-creation settings, they can act as neutral assistants, introducing ideas that are not bound by team hierarchies, experience levels or organizational culture [14, p. 3] [15, p. 252]. This neutrality can encourage broader participation, as team members may feel more empowered to challenge AI-generated ideas than those proposed by supervisors or senior colleagues.

Paulus and Yang (2000) highlight that effective group creativity depends on psychological safety, diversity of input and the ability to build on others’ contributions [16, p. 78]. LLMs can support these conditions by adding variety and novelty into this process. However, they may also risk reducing interactivity if participants begin to rely too heavily on machine input and treating AI suggestions as authoritative or as always right, rather than provisional [16, p. 80].

O’Toole and Horvát (2024) emphasize the importance of positioning AI

as a collaborative partner rather than a passive tool [14, p. 3]. Their research shows that co-creative systems work best when human users engage actively with AI suggestions, modifying, combining or even rejecting them. This form of interaction fosters a shared creative space where both human and machine inputs are treated as sources of inspiration rather than finished products.

Ultimately, the effectiveness of human-AI co-creation depends heavily on the mindset of the users and the structure of the interaction. Facilitated discussions, critical evaluation and reflection are crucial to ensure that the cooperation with LLMs enhances rather than replaces meaningful human contributions.

3.3 LLMs in Innovation Workshops

The integration of LLMs into innovation workshops marks a significant development in how creative processes are facilitated. When used strategically, LLMs can expand the ideation space, stimulate new directions and provide fresh perspectives, especially in the early phases of idea generation [13, p. 4]. Their ability to quickly generate a wide range of inputs allows participants to move beyond familiar thought patterns and explore more diverse possibilities [6, p. 2]. This ability to generate a vast amount of ideas can be especially beneficial in the early stages of brainstorming when the aim is to explore all potential angles and perspectives without narrowing down to a single solution.

However, LLMs are also effective in helping teams to break free from creative blockades by providing quick and novel suggestions. By presenting ideas that might not naturally occur to human participants, LLMs expand the pool of ideas available and ensure that discussions move beyond the commonly known paths. Their immediate response to prompts ensures the flow of ideas remains uninterrupted and the combination of human creativity and AI-generated suggestions accelerates the brainstorming process, as shown by Meincke et al. (2024), who found that teams using LLMs produced more ideas in less time and often also with higher feasibility ratings [13, p. 4]. This highlights the flexibility and speed at which LLMs can adjust to different innovation challenges, whether the goal is to disrupt existing models or improve incremental processes.

Despite these advantages, the use of LLMs also introduces some notable risks. One concern is the potential for surface-level novelty. These are ideas that appear creative at first, but lack depth or contextual relevance. LLMs can generate ideas that appear original but may lack the necessary substance to be truly impactful [7, p. 3]. Meincke et al. (2024) note that overreliance on AI-generated suggestions can lead to a repetitive cycle, where the generated

ideas resemble one another too much, which therefore reduces the diversity of concepts produced [13, p. 4]. This could potentially lead to creative stagnation, where innovation becomes mechanical rather than revolutionary.

It is also debated if the broader implications of integrating generative AI into collaborative processes are favourable. While LLMs can augment human creativity by providing unexpected inputs, their overuse might undermine human creativity’s intrinsic qualities. Dwivedi et al. (2023) warn that the increasing adoption of tools like ChatGPT may reinforce a tendency to defer decision-making and judgment to machines, which could be problematic in situations requiring nuanced human judgment and intuition [5, p. 6]. This is particularly relevant in creative scenarios where subjective evaluation and personal interpretation are crucial to the development of truly innovative ideas.

To address these concerns, researchers recommend embedding LLMs within clearly defined roles and structured frameworks. Instead of acting as autonomous generators of ideas, LLMs should be positioned as facilitators or sparring partners that provoke human reflection [5, p. 7]. Kumar et al. (2024) emphasize the importance of using interactive prompting strategies that encourage engagement between human users and the AI systems. These strategies, such as setting constraints, assigning creative roles to the AI and alternating between human- and machine-led phases, enhance the generative process and ensure that the AI serves as an active collaborator rather than a passive tool [10, p. 3–4].

In practice, this means designing innovation workshops that provide a dialogic process between humans and LLMs. For example, participants might critique AI-generated ideas before combining them with their own or use AI outputs as a divergent stimulus in convergent evaluation rounds. Such methods ensure that the workshop benefits from the speed and diversity of LLMs without sacrificing the depth, reflection and human agency that is essential in the creative process.

In conclusion, while LLMs offer valuable opportunities to enhance idea generation in innovation workshops, their success depends strongly on thoughtful integration. A careful balance between automation and human agency, clear guidance on AI usage and fostering reflective human-AI interaction are key factors in leveraging the full creative potential of generative AI.

4 Discussion

The previous sections demonstrate that LLMs can be valuable assets in structured ideation settings, especially within innovation workshops. The research findings indicate that LLMs excel in expanding the quantity of generated ideas, offering associative inputs and stimulating divergent thinking. These advantages align with empirical studies that underscore the utility of LLMs in supporting early-stage ideation, particularly when used with appropriate prompting techniques [10, p. 3–4], [13, p. 5]. These results are consistent with theoretical frameworks that frame creativity as a process that can be enhanced through external stimuli, knowledge recombination and the strategic use of tools such as LLMs [9, p. 6]. The synergy between human and machine capabilities allows for the enhancement of creative output, particularly in the context of idea generation where novelty and flexibility are primarily important.

However, the studies also reveal important limitations and conditions. While LLMs can increase the efficiency and fluency of idea generation, they do not necessarily enhance the originality or depth of ideas in the same way. This discrepancy aligns with concerns about the superficial novelty generated by LLMs, where outputs might lack the complex and meaningful insights that are often expected in truly creative ideas [7, p. 3] and [13, p. 4]. The technology is better suited for divergent thinking tasks, those that require a large volume of varied ideas, rather than the evaluative and goal-oriented thinking necessary for convergence. As such, LLMs should be understood not as replacements for human creativity, but as tools that amplify and complement it, especially when used in collaborative settings where their role is to broaden the scope of ideation rather than narrow it.

Furthermore, the integration of LLMs in creative workflows may alter how individuals and groups approach the ideation process. LLMs’ presence might shift the focus from creating original ideas to curating and refining them. As noted by Meincke et al. (2024), this may result in a form of creativity that is more editorial in nature, where participants filter and combine AI-generated ideas rather than coming up with entirely new concepts themselves [13, p. 4–5]. This shift in creative practice prompts important questions about the ownership and authorship of ideas, specifically, whether the human-AI collaboration results in genuinely innovative outcomes or simply a recombination of existing knowledge.

The effectiveness of LLM integration depends heavily on how teams use and frame these tools. When treated as collaborators or provocateurs, LLMs are more likely to provoke new ideas and increase engagement [14, p. 3]. However, when treated as authoritative sources or “black boxes,” LLMs may

restrict the creative space, limiting the range of exploration and undermining human agency. This dynamic is especially critical in group settings, where power imbalances and groupthink could influence how AI-generated ideas are perceived and acted upon [14, p. 3]. Therefore, fostering an environment where LLMs are used as co-creators, rather than authorities, is essential to maintaining an open and dynamic creative process.

In addition, the context and goals of the innovation workshop significantly affect the success of LLM integration. In highly exploratory or disruptive innovation settings, the unpredictable nature of LLM outputs may be an asset, because they can stimulate unexpected insights. However, for more refined, evaluative or risk-sensitive tasks, human judgment must remain central to the process. These contextual factors will determine whether AI serves as an enabler or a hindrance to the creative intent of the session. Thus, clear guidelines for LLM use, aligned with the specific goals of the workshop, are crucial to maximizing the effectiveness of human-AI collaboration.

In conclusion, LLMs should be regarded as tools that enable creativity, not as substitutes for human imagination. When thoughtfully integrated into structured innovation workshops, LLMs can provide valuable support in expanding idea generation, fostering reflection and generating diverse perspectives. The success of this integration depends on the balance of the strengths of AI, such as speed and variety, with the depth and contextual awareness that human participants bring to the creative process. In addition, providing clear guidance on how LLMs should be used, encouraging active engagement with AI-generated ideas and maintaining an iterative and reflective approach will ensure that the creative potential of LLMs is fully realized.

4.1 Limitations

This study is based exclusively on existing literature, which limits its empirical scope. The findings are based on a secondary analysis of published experiments, surveys and theoretical contributions. As such, the conclusions depend on the quality, representativeness and context of the reviewed sources. Many studies use controlled settings or artificial tasks, which may not fully capture the complexity of real-world innovation workshops.

In addition, the LLMs discussed, particularly GPT-4, are still rapidly evolving. Their capabilities, prompting mechanisms and integration into collaborative workflows are in flux [1, p. 4]. This means that the current understanding of their influence on creativity may shift in the near future as both models and user practices mature. Moreover, few studies so far have included long-term observations or mixed-method approaches that combine

quantitative performance with qualitative insights.

Finally, this paper does not address the ethical or organizational implications in depth, instead focusing on functional and cognitive aspects. Future work should explore these dimensions, including user trust, intellectual ownership and transparency.

4.2 Conclusion and Future Outlook

This paper explored how the integration of LLMs influences human creativity in idea generation processes within innovation workshops. Conclusions show that LLMs can meaningfully support creativity when embedded thoughtfully. They are particularly effective in divergent thinking, helping users generate more ideas, break out of cognitive ruts and explore new directions. However, their influence is not universally positive: It depends on the quality of human-AI interaction, the prompting strategy and the willingness of participants to critically engage with machine-generated output.

For innovation practitioners, the key takeaway is to frame LLMs as collaborators, not content providers. The best results come when LLMs are used to provoke discussion, broaden perspectives and accelerate iteration, without replacing human judgment or group dynamics.

Future research should focus on testing different workshop formats with LLM integration, using real teams and real challenges. Mixed-method studies, combining experimental design with participant interviews and behavioral tracking, would help capture the nuanced effects of LLMs on team creativity. Other promising directions include exploring personalized prompting systems and adaptive AI behavior that responds to user feedback [10, p. 5].

Ultimately, the collaboration between humans and LLMs offers great potential, if approached with critical awareness, thoughtful design, and a commitment to preserving the human core of creative innovation.

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