AI AND DESIGN CREATIVITY

Overview

Creativity plays a significant role in design and manufacturing, especially during the early stages. It is defined as "the process by which something so judged (to be creative) is produced", which initiates innovations, assists problem-solving, and increases a firm's market share. While a number of studies have investigated creativity in the design context, most have focused on small-scale settings, creativity still remains a notorious and elusive phenomenon. The aim of this large-scale case study is to provide a deeper understanding of the future of work for designers in a fast-changing world. The objectives of the case study involve exploring how humans perform in design creativity tasks, such as problem clarification and idea generation, compared with AI-generated results; and developing computational approaches to evaluate creativity at scale.

Who is involved

Data was collected from a broad participant pool of over 650 people to examine the impact of background and experience on creativity, including: professionals with design backgrounds, professionals without design backgrounds, students with design backgrounds, students without design backgrounds.

The case study aligns with DIGIT Lab's research theme of Digital Innovation, investigating both the opportunities and challenges associated with adopting digital technologies, particularly generative AI, for supporting the design of products, systems and services. It contributes to DIGIT Lab's remit of accelerating digital innovation across industries.

Challenges:

Lack of available datasets:
There is currently a lack of large and structured datasets capturing creativity, such as design requirements and ideas, produced by both humans and generative AI.

Expert creativity evaluation:
Creativity evaluation relies heavily on human expert judgements, which is particularly time-consuming and costly when assessing a large number of ideas.

Opportunities:

Automated creativity evaluation:
Developing computational methods, employing techniques such as Natural Language Processing (NLP) and Large Language Models (LLMs), to evaluate creativity at scale could enable more efficient and consistent evaluations.

AI for design:
This case study offers useful insights into where and how AI can augment and complement human creativity, informing future AI-driven design support tools.

Creativity evaluation framework using LLMs and Chain-of-Thought [2]
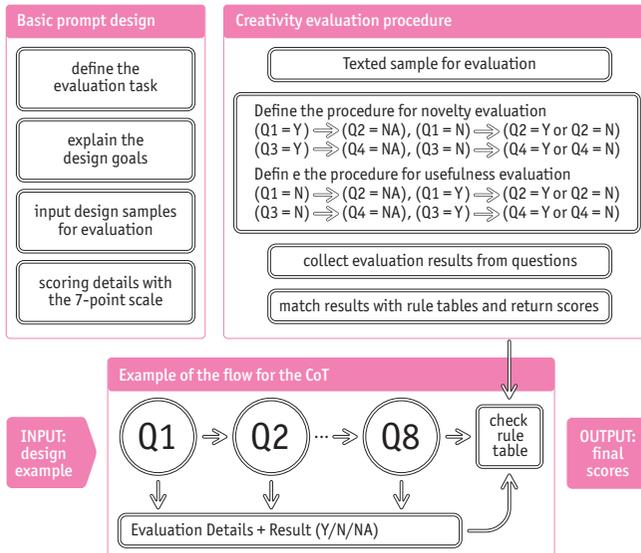
Outcomes:

Creativity dataset:
A large-scale dataset containing over 12,000 and 3,600 design requirements, and over 12,500 and 2,800 design ideas generated by ChatGPT and humans, respectively.

CoT for creativity evaluation:
Proposed an LLM-driven approach for design creativity evaluation, by adopting the Chain-of-Thoughts (CoT) prompting technique to enhance the evaluation reasoning capabilities of LLMs based on an existing creativity evaluation framework.

NLP for flexibility evaluation:
Developed scalable NLP techniques, both syntactical and semantical, to cluster ideas for measuring the flexibility aspects of creativity.

Activities:

Survey:
A large-scale survey study conducted to collect requirement and idea generation data generated by 680 human participants and 320 ChatGPT sessions, involving 2 familiar and 2 unfamiliar tasks.

Conference presentations:
Related work regarding the use of LLMs for creativity evaluation was presented in the International Conference on Engineering Design (ICED) 2025 and ASME 2025 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference Workshop.

Dissemination:
The survey results were disseminated as part of the AI and Design Workshop hosted at the Advanced Manufacturing Research Centre in 2024.

Summary and next steps:

This case study explores the performance of humans and AI in design creativity tasks, and their relationships, with a particular focus on problem clarification and idea generation. By collecting and analysing large-scale data from both human participants and AI, the study has contributed a large-scale dataset and introduced scalable computational methods for evaluating creativity. For the next steps, further studies will improve the reliability of the computational evaluation approaches and convert the findings into practical design support tools; the research team will engage with industry partners to explore opportunities for implementing the tools and approaches in the real world, delivering further impacts.

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Publications and outputs:

Zhang, J., Han, J., & Ahmed-Kristensen, S., (2025). [1] 'Exploring the use of LLMs to evaluate design creativity.' *Proceedings of the International Conference on Engineering Design* (ICED) 2025.

Zhang, J., Han, J., & Ahmed-Kristensen, S., (2025). [2] 'Chain-of-Thought for design creativity evaluation.' *Proceedings of the ASME 2025 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference.*

Li, W.Y., Han, J., & Ahmed-Kristensen, S., (2025). [3] *LLM and human generated ideas* (dataset). University of Exeter. https://doi.org/10.24378/exe.5746

> "We have collected the largest database to date of human and AI-generated ideas, enabling a clear understanding of the role of humans and LLM in creativity."

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