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Utopian or Dystopian Digital Futures?

Rethinking Applied Design Research

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Colophon

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The world is changing fast, and technology is becoming smarter and more intelligent. As Artificial Intelligence dominates the conversation — with Quantum Computing, Synthetic Data, and Organoid Intelligence on the horizon — designers face an urgent question: Are we heading toward Utopian or Dystopian digital futures?

This proceedings, featuring 11 in-depth contributions, addresses how these rapid digital developments fundamentally influence the work of the designer, the design process, and the applied design researcher. The authors are not looking for quick answers, but try to determine the future questions that emerge from the interaction between design and AI.

The authors explore the challenges and opportunities AI presents to the design profession, discussing the value of human creativity when AI can generate unlimited amounts of creative content instantly. This publication is a necessary exploration for the community of Applied Design Researchers, seeking the right questions to deal with the complex relationship between design and an increasingly intelligent world.

This publication documents the results of the NADR 2025 knowledge cycle. Each year, NADR explores a specific research theme, supporting an exchange of knowledge and experience to further develop the field of Applied Design Research. The proceedings were presented at the NADR symposium on October 20, 2025, during the Dutch Design Week in Eindhoven.

From Chaos to Support - Design Companies and Their Adoption of AI

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Abstract

Artificial Intelligence (AI) is rapidly entering the design field, offering new opportunities for creativity, efficiency, and decision-making, while at the same time creating uncertainty for design professionals. This study investigates how small and medium-sized design agencies explore and adopt AI in their workflows, and how adoption can be supported in ways that align with company culture and values.

A qualitative, practice-based research approach was applied with three Dutch design agencies, combining interviews, testing sessions, and focus groups. Findings show that AI is currently used mainly in an experimental phase, focused on ideation, research, and automating routine tasks. Designers recognize opportunities for AI as a creative partner and efficiency booster, but face challenges such as low AI literacy, divergent attitudes within teams, concerns about professional identity, unclear client expectations, and the limited reliability of tools.

To address these challenges, five interdependent conditions for AI adoption were identified: creating a safe learning environment, fostering trust and literacy, handling tools responsibly, developing an explicit AI strategy, and encouraging open communication. In addition, three personas (Explorer, Executor, Innovator) and the role of organizational culture were found to strongly influence adoption.

As a tangible outcome, a workshop was developed to help design teams reflect on AI's role, connect adoption strategies to company culture, and translate insights into a concrete roadmap.

Introduction

Artificial Intelligence (AI) is rapidly transforming the design field. New tools emerge every day, offering automation, inspiration, and new ways of creating. For design agencies, this development is both exciting and disruptive. While AI promises to extend creative skills, increase efficiency, and support decision-making, its speed of development also creates uncertainty. Designers face questions about when AI truly adds value, how it can be embedded in design processes, and what it means for professional identity and craftsmanship.

These questions formed the starting point for the research project *AI in Ontwerp*, initiated by the research group Industrial Design at Saxion University of Applied Sciences (Enschede) with partners Dynteq, DE Design, 100%FAT and AI-tool initiative RenderAI. The project aimed to support product design agencies in implementing AI in their workflows in ways that align with their culture, values, and way of working by answering the research question:

What do design agencies and their employees need to responsibly and effectively adopt AI in their design process?

In this article, we outline our research process and its outcomes. We first describe the used approach and methods. Then, we present the main findings: what opportunities and challenges designers encounter in using AI and conditions needed for collaboratively adoption of AI in a design agency. Finally, we describe the result of this study: A workshop that helps design teams reflect on their practices and develop strategies for AI adoption that fit their culture and values.

Method

This research combined qualitative methods with close collaboration in practice. Three Dutch design agencies (small and medium-sized enterprises) were partners in this project, each with a distinct profile: differing in size, focus, company culture and way of working. This variety provided valuable insights into how AI may play different roles depending on company context.

Table 1 Participating design agencies

Company	**DE Design**	**100% FAT**	**Dynteq**
Size	Medium-sized around 15 employees (multidisciplinary).	Small-sized around 6 employees (multidisciplinary).	Medium-sized around 15 employees (multidisciplinary).
Focus	B2B product design with a strong emphasis on styling and visual appeal. They do not manufacture the products themselves, but they do support their clients in making products ready for production.	Combining art and technology by creating interactive experiences. With their own workshops, they built products in-house from idea to final product.	Product design and engineering and delivering production-ready concepts with a strong focus on prototyping and functional performance for clients at various industries.

To understand how these agencies experience AI and can adopt AI in their workflows, we applied a multi-method approach (figure 1). The method includes: interviews with designers, design lecturers and AI expert; an exploration session with product design students; a testing phase at design agencies which is tracked with interviews and questionnaires and two focus groups with participants from the testing phase and AI experts to combine our experiences and views and work towards adoption. To support adoption we have developed a workshop.

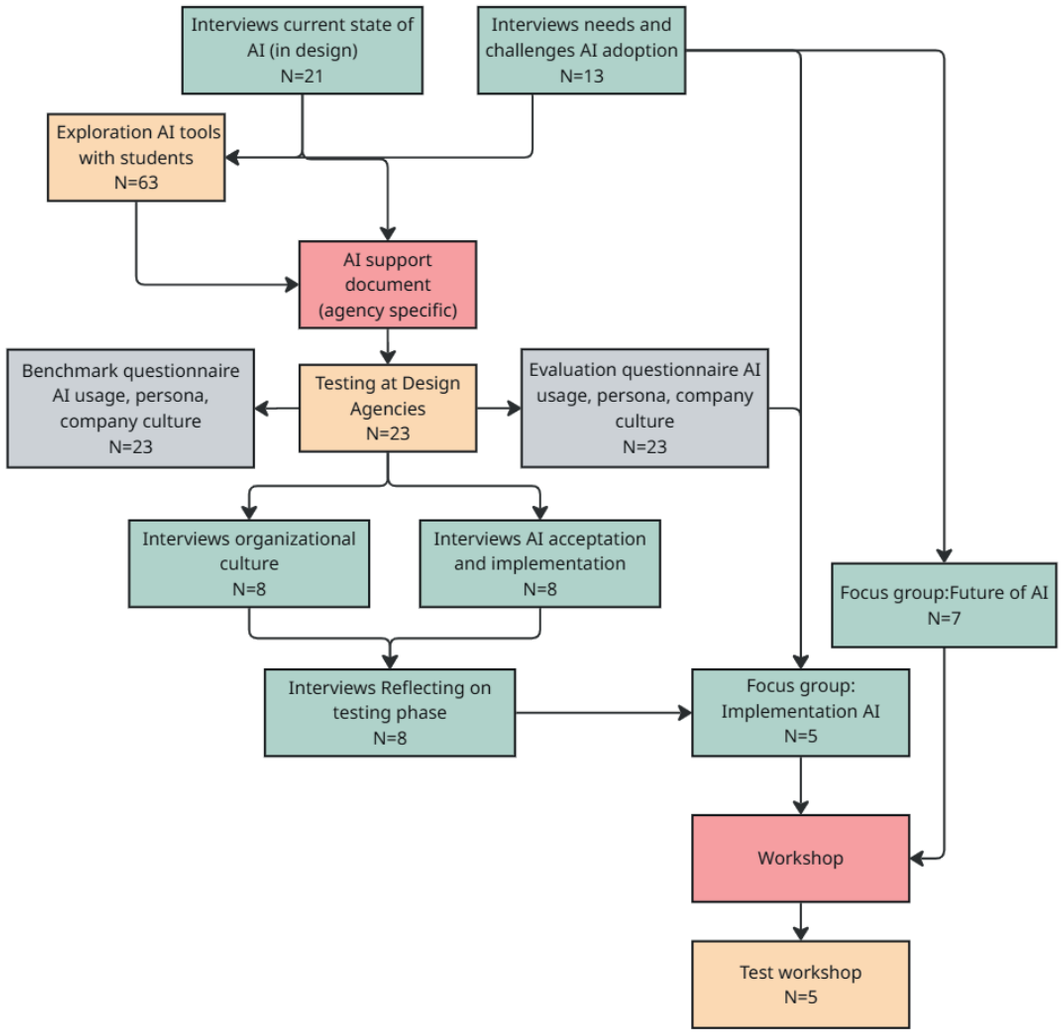


Figure 1 Research activities with designers

Opportunities and challenges

During the first interviews (October 2024), most designers were still in an experimental phase, using AI tools to explore possibilities rather than applying them to real client projects. At that point, AI is mainly used for ideation, research, and automation of routine tasks. Some tools are being explored, mostly generative AI models like Midjourney, Vizcom, Dall-E, and Bing for generating visuals, and Large Language Models (LLMs) like ChatGPT and Copilot for generating text and code or research purposes. However, the integration of these tools into daily workflows is still in its early stages. While designers use these tools to support creative processes, they remain hesitant to rely on them fully for client-facing work, and most agencies report almost no experience with these tools in formal projects.

AI brings clear opportunities to designers, see figure 2. Based on the interviews, the testing phase with design agencies and the focus group *Future of AI*, we see that many designers see AI as a creative buddy, offering inspiration and alternative directions during ideation. They expect AI to increasingly support routine work in the future, such as automating repetitive CAD (computer-aided design) tasks like adding bolts. Other opportunities include using AI for patent and IP research, producing faster renders to support client communication and extending the capabilities of teams by taking on roles as assistant, efficiency booster, or quality controller. Designers noted that AI in cases could improve the quality of their work, particularly in tasks that normally have low priority (for example, rendering

backgrounds for product visualizations). In more important, high priority tasks, (for example, final rendering or concept development), AI could not provide them with enough control and missed knowledge of the product design context to optimize the tasks according to their needs.

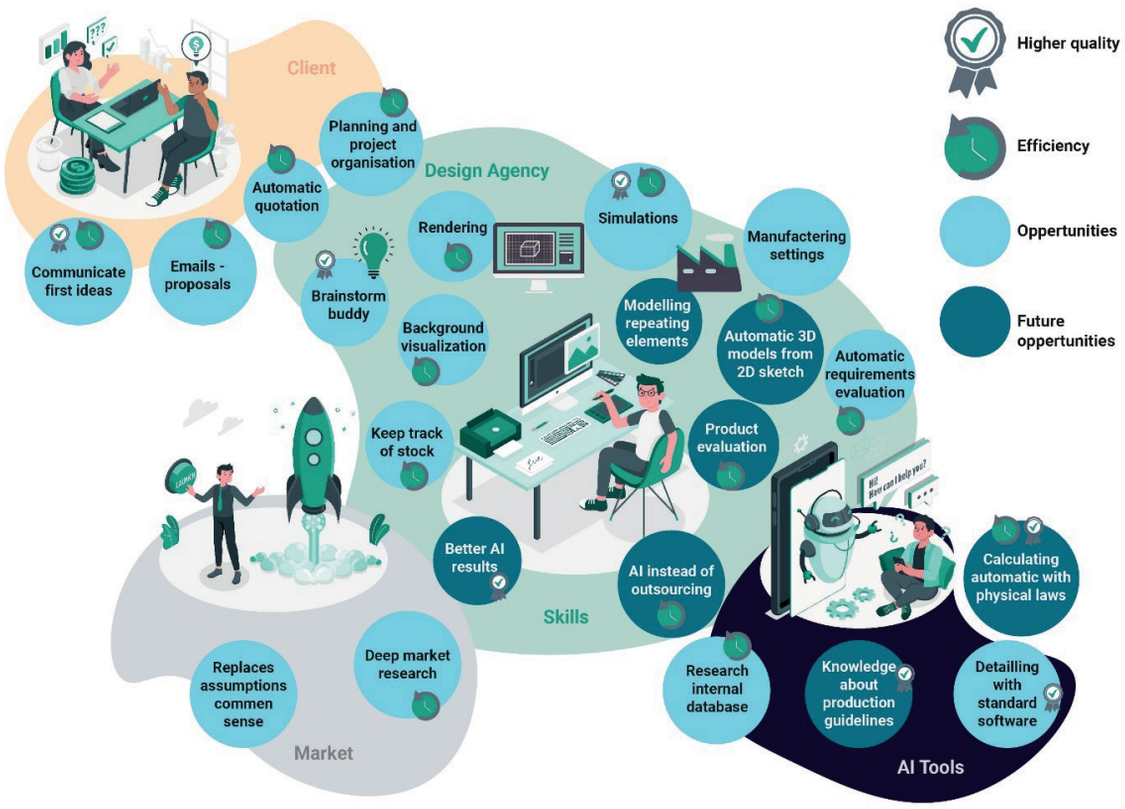


Figure 2: Key Opportunities

Designers also face challenges in the use of AI (figure 3). These challenges span multiple layers: from internal challenges within the organisation to external challenges related to clients and the tools themselves.

Internally, many designers struggle with differing views on AI. While some see it as a creative enhancement, others perceive it as a shortcut or even 'cheating,' leading to friction within teams. Designers also expressed concerns about losing control over the design process, losing creativity and identity.

Externally, challenges arise from unclear expectations and communication with clients, as well as the lack of shared guidelines and strategies within the company for using AI. For example, when you use renders to visualize your first ideas, clients will criticize details and expect the final product to be almost finished. Additionally, there are certain tasks AI still cannot do, such as understanding context, ensuring technical accuracy for engineering calculations or generating 3D models. Many tools are still perceived as unreliable on details and nuance of the design context and of inconsistent of insufficient quality for client work.

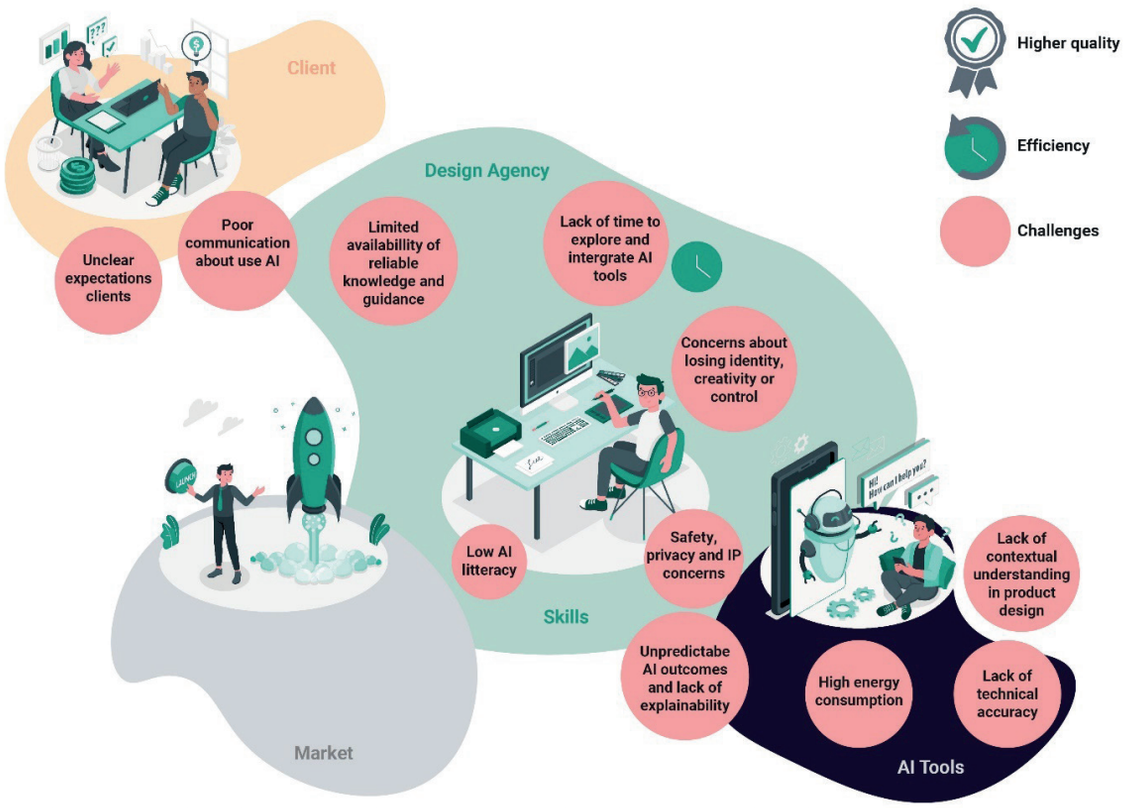


Figure 3: Key Challenges

Needs for collaborative AI adoption

During the testing phase at the design agencies, the adoption process was evaluated and analysed. These results were taken as input for the focus group *Implementation of AI*. In the focus group, designers chose the most important challenges and flipped these into strategies for good AI adoption. The two choses key challenges were: *Communication with clients* and *low AI literacy* within the teams. Designers emphasized the importance of shared conditions and clear guidelines for AI usage, as these help to prevent friction within teams and reduce fears of misuse. The five themes that are found in this focus group are presented in Figure 4. These themes are: *Good and safe learning environment, Trust and literacy, Responsible AI use, AI strategy and open communication*. These themes are the conditions that can support agencies in developing structured implementation plans and embedding AI more effectively in the design process. The conditions are not independent of each other, improvement of one of the conditions can lead to improvement of the other conditions.

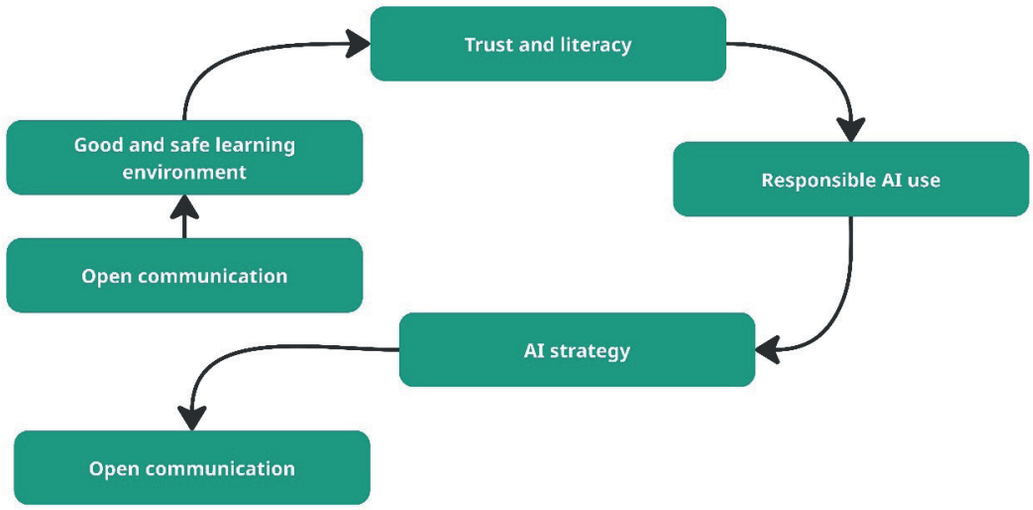


Figure 4: Conditions for implementation strategy

The goal of good implementation is that design agencies have a good understanding of their company culture and that all team members understand what AI is, what it can do, and when it should or should not be used. Equally important is that designers **trust** their colleagues to use AI in a responsible way. Reaching this point requires that employees **use AI tools responsibly**. This means being aware of potential negative effects, relevant laws and regulations, and privacy concerns. To support careful use, teams need both **trust in AI** and the right level of **literacy**, depending on the complexity of the tools they want to adopt. Trust is built when designers have positive experiences with AI tools and can see their value in practice. For literacy and trust to grow, there must be a **good and safe learning environment**. Teams need time and space to explore AI, make mistakes, and most importantly, share both good and bad experiences**. Open communication** within the company is therefore essential. By talking openly about AI, teams increase their collective knowledge and confidence. With these experiences, companies can together make an AI-adoption plan. Such discussions also prevent frustration or shame between colleagues with different views and reduce the risk of inefficiency or conflict when AI is introduced. Finally, when agencies have an AI-strategy, use AI responsibly and make deliberate choices, they can communicate this clearly, both within the team and externally to clients and partners. This creates ownership, clarity and direction, and transparency, and supports a more consistent and responsible use of AI.

With these conditions met, the company can go from a point where AI is new and is experienced as chaotic, towards working with AI in a way that AI is supporting, enriching and inspiring for the design process. This process is visualized in Figure 5. By trying out new tools, reflecting on the results, and integrating successful outcomes, their knowledge about AI grows. With practical examples and shared experiences, agencies move step by step towards the desired situation.

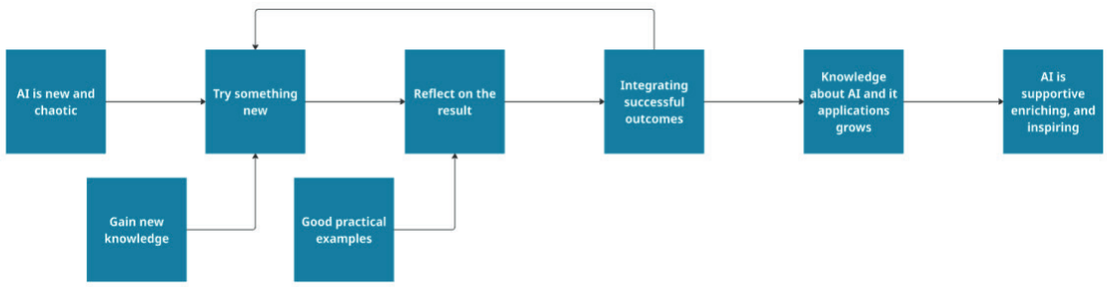


Figure 5: Iterative learning process of AI implementation.

Based on these results we concluded that there is a clear need for a concrete company AI-strategy, including agreements and preconditions for the use of AI. This strategy should match the company culture, and it should be developed together with employees for optimal uptake. To support these conversations and translate them into concrete strategies, we developed a workshop that guides design teams from reflection towards strategy.

From Reflection to Strategy- Workshop

The tangible outcome of this project is a workshop that helps agencies explore the role of AI in their own practice. The workshop is intended as a practical tool for design teams and builds on the findings from interviews and focus groups and substantiated with literature. Its purpose is twofold: To create space for reflection on how AI affects their design process, and to help teams develop a concrete strategy for adoption that fits their culture and way of working.

Step one: Persona's

The workshop is designed as a step-by-step process. It starts with identifying personas, since the current-situation-interviews showed that designer's attitudes vary widely: some are eager to experiment, while others remain sceptical. We defined three personas:

- **The Explorer** tries out popular and accessible tools. They are motivated by efficiency and adopt tools relatively quickly, but they tend to accept results at face value, even if quality is limited.
- **The Executor** has little knowledge of AI. They may try it because others do so, but they rarely experiment. If the first attempt fails, they easily stop using it. They want the technology to work. They are often skeptical of AI, seeing it as something that encourages laziness. Their lack of understanding makes them more prone to misuse.
- **The Innovator** invests time to explore AI in depth. They have realistic expectations and a strong understanding of how to use AI effectively. For them, AI is a way to extend their skills, improve quality, and support creative thinking.

An overview of the three persona's and the connecting factors influencing AI adoption as identified in the interviews are shown in Table 2.

Table 2: Persona's and factors influencing AI adoption

	The explorer	The executor	The innovator
Understanding AI	Limited understanding.	No understanding.	Understands it to a certain extend.
Time to learn	Copies and pastes techniques from videos.	Give it one try to get the right result.	Put a few hours per week in experimenting.
Intrinsic motivation	Slightly motivated for personal gain.	No intrinsic motivation to dive into it.	Motivated to keep learning and staying up to date.
Expectations of AI	Helps increase their efficiency quite easily.	High expectations that are hard to meet.	Realistic. Adjusts their expectations based on their experiences.
Output quality	Accept the output quality quite easily.	Little to not trust in the output quality. Hard to get the preferred result.	Hight output quality. They continue until their preferred result is generated.

Negative impact AI	Partly aware, but pros out weight cons.	'AI makes you laze'.	Wel-informed and takes this information into consideration while using AI.
Discoverability tools	Use the popular tools and the ones they hear others talk about.	Only use popular and widely known tools.	Puts more effort into finding tools that fit them.
Function AI	Efficiency, Assistant Creative.	Efficiency.	Skill-extension, Improving quality Creative.

With the help of personas the different attitudes toward AI within the team are explored and the divergent perspectives are made explicit. The personas can be identified based on several questions, that we developed based on the interviews and tested with a group designers. The questions are stated in table 3, participants need to respond with 'agree' or 'disagree,' the persona with the highest number of agreements represents their profile best.

Table 3: Questions for identifying personas

Question	Persona
I get frustrated if an AI tool does not give the desired result within 15 minutes.	Explorer
I am motivated to test new AI tools.	Executor
I look up information about technological developments in the field of AI.	Executor
I can perform my design tasks better than an AI.	Innovators
I can perform my design tasks better by using AI tools.	Explorer
Using AI tools in the design process feels like cheating.	Innovators
The use of AI tools lowers the value of the final product.	Innovators
I am afraid we will miss the boat if we delay AI adoption.	Explorer
I take on more difficult tasks because I know I can rely on AI.	Executor

Step two: Company culture

Next step is identifying the company culture. Interviews showed that company culture plays a decisive role in AI adoption. In addition, studies show that organizational culture plays an important role in creating and carrying out strategies. Companies need to understand their own organizational culture to shape what strategies they can achieve (Schein, 1990). As Muscalu, 2014, states, changing organizational culture requires awareness about the current culture, and communication about the changing attitudes within their company. Furthermore, employee's attitudes play an important role in forming the company culture. The exercise used within the workshop is based on the manifestations culture model by Hofstede et al., 1990 and used to connect AI adoption to the values, norms, and identity of the company. Although Hofstede's model was originally developed in 1990, it remains widely used in organizational research and practice to analyse cultural influences on behaviour and technology adoption (Minkov & Hofstede, 2011; Taras et al., 2012).

Hofstede states values and practices as key elements of culture. According to their model, culture manifests through three types of practices, namely, symbols, heroes, and rituals, and through underlying values (see Figure 6).

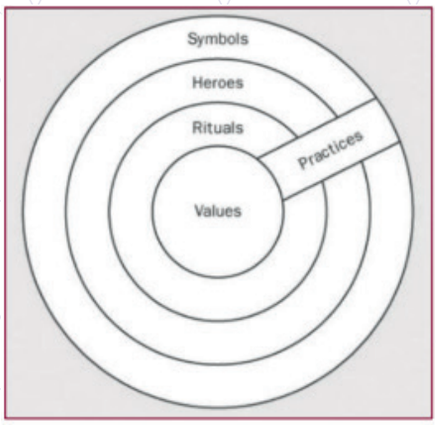
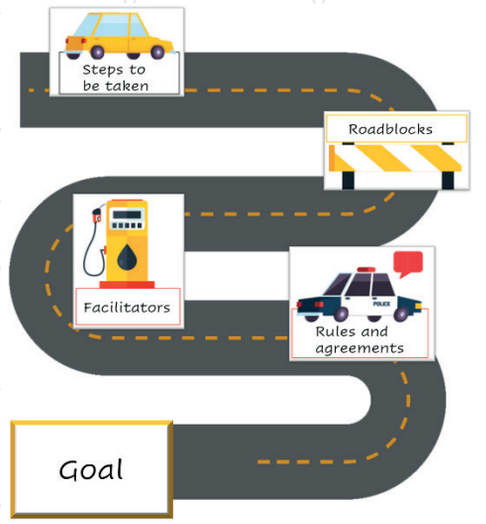


Figure 6: Manifestations of culture by Hofstede (1990). Retrieved from: https://www.researchgate.net/figure/Hofstedes-2010-onion manifestations-of culture_fig1_369094847

To assess practices, Hofstede et al. (1990) used six dimensions:

- Process-oriented vs. Result-oriented
- Employee-oriented vs. Job-oriented
- Parochial vs. Professional
- Open system vs. Closed system
- Loose control vs. Tight control
- Normative vs. Pragmatic

Within the workshop, these dimensions are used to start a group conversation about the company culture. This provides a general understanding of the company culture and establishes the foundation



ep.

Figure 7 Cards and playboard for the roadmap serious game in the workshop.

Step 3 Roadmap

Step three is about defining learning goals to clarify what knowledge and skills are needed to use AI responsibly and effectively. Participants need to write down together a set of preconditions when they want to use AI and when not. This is input for the roadmap game (Figure 7), where they translate the reflections into a concrete strategy, outlining practical steps for experimentation, agreements, and integration in the design process.

Reflection on workshop

The workshop was tested with a team of Industrial Design lecturers at Saxion. Participants' reactions were collected immediately after the session through group discussions, and a follow-up email was sent a few days later to gather additional feedback. Overall, the workshop was perceived as well-structured and coherent, guiding the group effectively from their current situation toward a desired AI-related future. It facilitated meaningful discussions and the exchange of ideas within the team. As a next step, we will improve the workshop and develop a serious game that teams can use independently to explore AI adoption and AI strategy within their own organizations.

Conclusion

Our research shows that AI is currently used primarily in an experimental phase. Designers recognize both opportunities and challenges in integrating AI into their work. Despite this interest, there is still little structured reflection or strategy regarding AI within design teams.

To address this, we developed a workshop based on personas and company culture, designed to help teams reflect on AI's role and translate insights into a practical implementation plan. The workshop has been well received by participants, and we believe it holds the potential to guide design agencies in developing a clear AI strategy. By providing a structured process, the workshop helps move teams from perceiving AI as chaotic and uncertain to seeing it as a supportive, enriching, and inspirational tool in the design process. This transformation starts by treating AI adoption as a design challenge itself: setting goals, experimenting, and translating insights into a plan that fits the team.

Key take aways

- AI adoption in creative SMEs is supported by five interdependent conditions:
  - Safe learning environment
  - Trust and literacy
  - Responsible use of AI
  - Open communication
- Designers face multi-layered challenges:
  - Internal: differences in team attitudes, low AI literacy, fear of losing identity
  - External: unclear client expectations, unreliable tools, lack of shared strategy
- Successful AI integration requires more than tools: a shared strategy aligned with company culture and iterative learning are necessary to embed AI meaningfully in the design process.
- Currently, AI is used experimentally and mainly for small tasks.
- Future opportunities: AI as a creative partner, efficiency booster, and quality enhancer, especially for lower-priority or routine work.
- The value of AI in the future depends on how well it understands the design context, allowing designers to have more control over outcomes and better adjust results to their needs.

Contribution Disclosure

Anne Pasman was responsible for conceptualization, methodology, validation, and writing – review & editing. Maran Lamberts performed the validation and formal analysis, conducted the investigation, prepared the original draft, and created visualizations. Debbie Waninge conducted the investigation, contributed to the original draft, and created visualizations. Merlijn Smits contributed to methodology and writing – review & editing. Editorial assistance was provided by ChatGPT (OpenAI), which was used for grammar and style corrections.

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‘Now You See It’: Interrogating AI Through Friction Design

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Abstract

Though in digital design it is common, desirable even, to avoid friction, this paper is an invitation to designers to apply friction as a design principle to foster awareness and ownership in AI in society. AI applications and tools are designed in such a way that its workings remain invisible. The labour that is done for AI, the data people themselves often unconsciously contribute, and the creative work that is appropriated and mimicked by AI all remain, for the most part, under the radar and unquestioned.

In this paper, we ask how we can employ friction to facilitate conversations about AI that move beyond its mythic nature and help increase the sense of ownership about the future of AI. We report on a research-through-design experiment, where students were asked to design for friction to increase awareness about AI and its workings. The experiment provided three main insights: i) Design students design for the direct result, not the aspired outcome; ii) The focus on user-centredness of design education limits critical reflection on the work made; iii) Designing for friction opens new ways of looking at design.

With this paper, we hope to inspire designers and developers to interrogate how they design and develop AI, and for which use they are doing so. As part of the broader project ‘What if AI’ and the AI, Media and Democracy Lab, we aim to inspire people to interrogate the design and use of AI and the individual and collective consequences.

We conclude that a seamless and frictionless world is entirely predictable, and therefor provides no possibility for a future, but only builds a continuous present, as AI does. Designers can help us break out of this loop. We believe that designers are most equipped to help foster care, engagement and build the new, though this may mean teaching students some core competencies that challenge dominant features of what is now considered ‘good design’, from usability and predictability to comfort and seamlessness.

Introduction

'Friction is rarely seen as a good aspect of design' (Lauritzen, 2022), the aim of designers is mostly to reduce it as much as possible in pursuit of greater usability (Ruckenstein, 2023). Yet, in this paper we call on designers and design researchers to explore how friction can help us create better (relations with) Artificial Intelligence (AI). AI is designed in such a way that its workings remain invisible. The labour that is done for AI, the data people themselves often unconsciously contribute, and the creative work that is appropriated and mimicked by AI all remain, for the most part, under the radar and unquestioned.

In this contribution we ask: To what extent does the frictionless design of generative AI tools that people actively interact with, add to the sense of elusiveness of AI? The design of frictionless interaction in current AI tools contributes to the perception of AI as an inevitable technological development that appears to emerge naturally, without visible policy or design choices. This masks the human responsibility behind its development and its use. As a result, AI is often seen as having a mythical or autonomous character. Interactions with AI chatbots are often deliberately designed to be experienced as conversations with a human being (see for instance, Paterson, 2025): chatbots generate human language, use first person pronouns, ask questions and offer help, just like a person would do.

Our research question is: how can we facilitate conversations about AI that move beyond its mythic nature, and help increase the sense of ownership about the future of AI? Specifically in this paper we consider the role that designers play in this and how friction can be used as a design principle. We argue that it is one of the responsibilities of designers to make visible and explainable how AI works, so that users can actively explore and express expectations and needs regarding how AI is designed and employed.

We consider friction as one of the ways in which designers and research-through-design can facilitate conversations about AI, increase awareness and ultimately foster a sense of ownership of AI. In our contribution we present our findings from a research-through-design experiment where we asked design students to use friction to design for more awareness about AI. With this project we aim to develop methods that help make explicit the emotions, myths and needs regarding AI that otherwise remain unspoken, and perhaps even invisible for people themselves.

One of these methods involves the creation of so called 'provocatypes', or 'provotypes', experiments with critical and playful interfaces that considered how an interaction with ChatGPT could be distorted in order to make people aware of the hidden labour that's at the core of the training of Large Language Models or demystify the technology that's behind an AI chatbot. How can that which remains invisible in the workings of AI made visible?

Ultimately, we challenge the practice of 'frictionless living', which Minna Ruckenstein (2023: 8) defines as stemming from 'a man-machine symbiosis, in which the human is unaware of being gently directed by forces of automation, is the ultimate accomplishment.' In its place we ask for experiments by designers that understand friction as an 'essential ingredient that makes up our humanness and sparks human connection', creating 'a lively, intrinsic experience' where all senses are included (Maurer, Wouters & Barancová, 2023).

Countering mythic fictions through creative friction

Though there is ample news reporting on AI (see for instance Bunz & Braghieri, 2022; Nguyen, 2023; Meissner, 2024; Ittefaq, et al. 2025), there remain many myths that surround AI (Natale & Ballatore, 2020; Emmert-Streib, 2020; Ballatore & Natale, 2023; Bewersdorff et al., 2023). With AI's undeniable presence in society and multi-fold media coverage on its consequences in a variety of domains, it is important to break the mythic nature of AI and foster inclusive conversations about AI.

The call to bring in friction into this world that strives for 'seamlessness' and in which the goal is to 'eliminate friction', is not a call for bringing in 'anger or conflict, nor is it malfunctioning technology' (Maurer, Wouters & Barancová, 2023). It is rather to invite a playful, yet earnest consideration of what is lost, what remains hidden, and who is forgotten or underserved when eliminating friction as a key value in the design of AI. Bringing in the senses and inviting emotions, is a core way, we argue, to invite conversations, inspire awareness, and ultimately foster ownership in the role of AI in society. As Maurer, Wouters & Barancová (2023) observe:

> *Friction is resistance. It derives from physical interaction between humans, and humans and things – its reach is holistic. All senses, elements and emotions play a role: sight, sound, smell, taste, touch, air, earth, temperature, agitation, passion, joy, sadness... (Maurer, Wouters & Barancová, 2023)*

Friction is needed for engagement and care (ibid). What would happen if we would not reduce, but play with elements of friction in all its forms, including the 'unpredictable, often frustrating, yet essential encounters with human otherness' (Alencar, 2025)?

Designing Friction: A Research-through-Design Experiment

To explore what the role of friction could be in designing AI, we employ a research-through-design approach and developed an experiment where we gave students the following assignment: Develop a chatbot that inspires critical reflection about their use of GenAI, making sure the tool has wide appeal and is not harmful for the user and the environment.

Over the course of ten weeks a team of three students worked on this project as part of the Minor Creative Research. The students were coached by Frank Kloos, co-author of this chapter, and student-assistant Nelson Tausk. Where Frank is a lecturer in the bachelor's degree where this Minor is hosted (Communication and Multimedia Design), Nelson had no previous connection and is also not trained in Design (but was at that time a Master student in the degree Cultural Data and AI, in the Media Studies department of the University of Amsterdam).

The students were given the Designing Friction manifesto of Maurer, Wouters & Barancová (2023) as the basis for their assignment and were asked to consider these principles: i) discomfort, ii) time delay, iii) engage the body and iv) non-positive. They were also provided guidelines on responsible AI by Cole Stryker (2024), that helped guide the students in the broader development of the tool and ethical considerations.

The students build an actual working chatbot, using Mistral (Figures 1 and 2 provide illustration of the interface). They describe the tool as follows:

> *FrictionGPT is a chatbot designed as a response to loss of friction in our interaction with technology. The aim of seamlessness or frictionless design for technology eradicates the engagement and care that we have for it. Therefore, our goal is to challenge the users' interaction with technology, making them more conscious and critical, especially urgent in the age of Artificial Intelligence. FrictionGPT is inspired by the artists Luna Maurer and Roel Wouters their work DESIGNING FRICTION A call for friction in digital culture. They propose to embrace friction instead of eliminating it and through that fashion making space for humanness in the design of technology. In our project we have explored the proposed ways to implement friction through design; discomfort, time delay, engage the body, non-positive.*

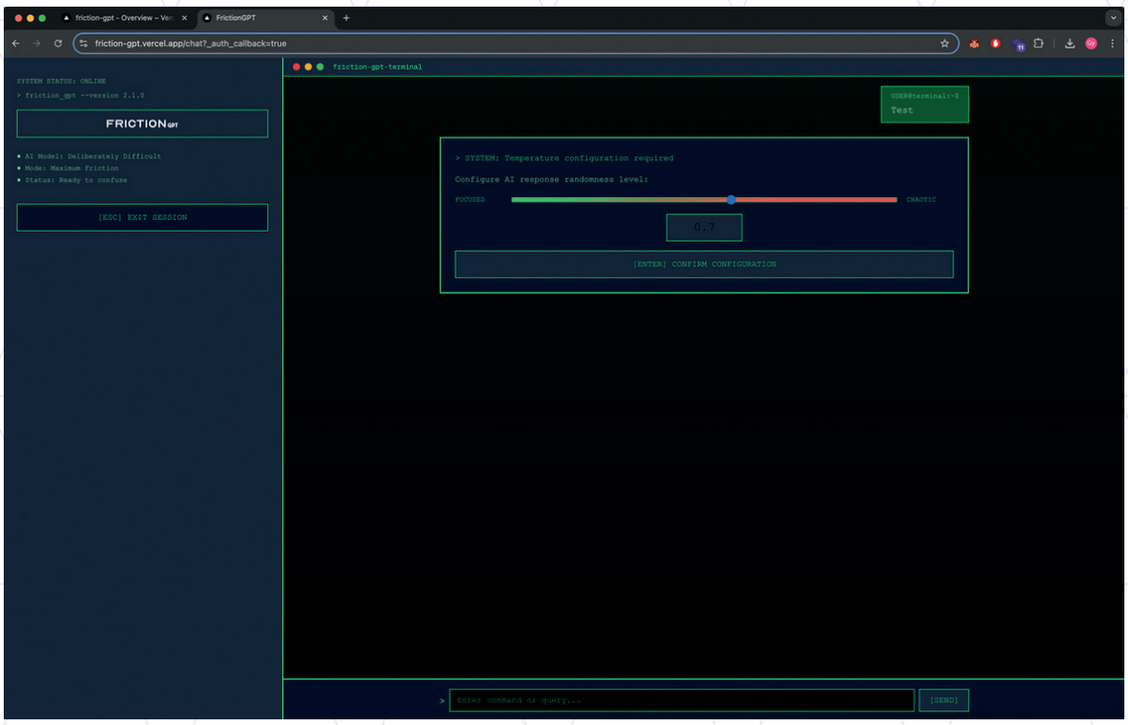

Figure 1: Screenshot of friction-gpt chatbot interface (temperature setting)

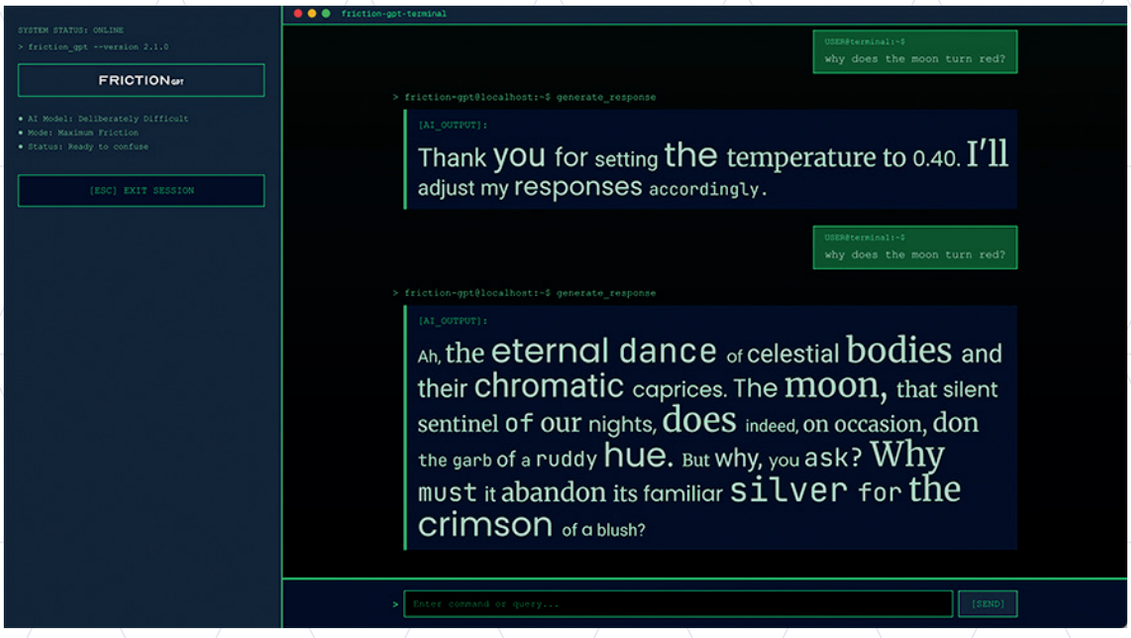

Figure 2: Screenshot of friction-gpt chatbot interface (response)

Below we discuss our findings and give key learnings from this experiment at the end. In short, we trained our students too well. It was hard for them to break out of the frame of 'user-friendly design' and give up seamlessness in favour of playing with elements of friction.

Design students design for the direct result, not the aspired outcome

Within the project it became clear that students had been taught (too well) how to design for specific results. They started with a narrow idea of what friction was, which only widened as they got feedback on their design. Though in the project students realised friction was considered a means to an end, namely awareness of how the technology works, students did not start with the end in mind. Rather than considering the manyfold ways in which you could design something that would allow people to increase awareness, they would state 'with this tool we aim to increase awareness'.

The design itself then was focused on creating *friction* as result, instead of designing for *awareness* as outcome by means of friction. Friction in this frame seemed to be considered as the 'solution' for the 'problem' of awareness. This also became clear in the 'usability' tests that students did, where they

tested if the tool 'worked'. Whether it worked mainly considered whether people responded to the friction, but not so much what it inspired, whether it allowed for more questions, conversations, interest or awareness.

The focus on user-centredness limits critical reflection on the work

One of the main insights of the projects is that the training that students have in user-centred design creates a very specific orientation to how their creative process works. Students wanted to 'deliver' friction, as if we were the customer who commissioned a specific tool that had to work in a specific way. The first iteration of the tool that the students developed was still very slick looking, ticking all the boxes of 'good' design, using standard design patterns and recognisable texts and visuals. The students were highly oriented towards this idea of creating an 'ideal' design for a stereotypical user.

Students kept falling back on what they had learnt: user-friendly and recognisable design. This led to predictable choices, based in patterns that are recognisable for people and inspire 'intuitive' employment of the tool. Only when probed and challenged, students came loose from this frame and started to play with other options. We developed and used different methods to spur creativity and to let students break out of their design habits. It was clear that they had been trained in such a way that all deviations were almost unthinkable. As the process continued, students asked many a time 'is this allowed?!' as they started to take liberties in creating friction in their design.

Designing for friction opens new ways of looking at design

As students started to broaden out and took paths they did not realise they were 'allowed' to take in their design, there was another interesting broadening of perspective: In trying to design for friction, students became aware of how all design choices are entangled. The aim to design for friction was to increase awareness of the interaction with the technology and all that is behind it that is invisible.

They started to realise this meant they needed to consider many different design choices too. For instance, to create an AI that makes visible that which is invisible, also means you do not let it pretend to be a person. To show it's not a person, you can play with font, the look and feel of the landing page, the log-in system and interface. And to design for a responsible AI, also means you need to consider elements such as the terms of service and the dataset that is used.

Discussion: Design for future possibilities

We started this paper with discussing the myths around AI and the opaqueness of its workings. Our paper is not a dystopian contribution, nor is it utopian one. Rather, it aims to interrogate and inspire others to interrogate – to break the myths and make AI's working and impact visible. First and foremost, with this paper, we hope to inspire designers and developers to interrogate how they design and develop AI, and for which use they are doing so. And with our broader project we aim to inspire all people (for not wanting to use the term 'user' here) to interrogate the design and use of AI and the individual and collective consequences.

We do not aim for a tool such as the 'Friction GTP' chatbot that students made to be a viable, sustainable tool. Inspired by the interrogative design approach, its function is like a band aid that shows something is wrong. The tool would show that there is something lacking in design, and in the way in which AI now functions in society, where there is a need for awareness and agency amongst those affected by it. The band aid is there to remind us of this and to call for attention for the question: can we do it differently?

Why would we want to do it differently, beyond inspiring awareness and agency? What is at stake here is movement for and opening of future potential. As philosopher Miriam Rasch reminds us, that to remove friction is to stand still (Rasch in: Maurer, Wouters & Barancová, 2023). Similarly, Han (2022: 42) observes: 'Artificial intelligence learns from the past. The future it computes is not a future in the proper sense.' How then, can we build AI and inspire use of it in such a way that it opens new possibilities, rather than forecloses.

This is what the call for friction is aimed at: to inspire engagement and care, to build new futures. The user-centredness, and the personalisation that is driving the seamlessness of our relationship with AI, delivers us a predictable future, and leaves us devoid of the new and the other (see also Elliot, 2023;

Han, 2022). Ultimately, as Ana Catarina de Alencar (2025) poignantly reminds us: the seamlessness and predictability of AI 'weakens our ability to navigate the discomforts and demands of democratic coexistence'.

Can we build an AI that confronts, challenges and counters our thinking? There are already those who design prompts to use AI for exactly this (see for instance, Toscano, 2025). Such calls for creative use of AI are very welcome. We here ask designers and developers to consider the ways in which they can employ this in their process and even embed it in the tools they design and build.

If we agree that a 'completely predictable future is no future, but a continuous present' (Maurer, Wouters & Barancová, 2023), how then can designers help us break out of this loop? We believe that designers are most equipped to help foster care, engagement and build the new, though this may mean teaching students some core competencies that challenge dominant features of what is now considered 'good design', from usability and predictability to comfort and seamlessness.

Key takeaways

From our research-through-design experiment, we have been able to gain first insights into the potential of an interrogative design approach and designing friction in AI. Our key takeaways:

- We need to consider the wider consequences of the focus of user-centred design in education and practice and what is lost in this focus.
- To understand and interrogate the role of AI in society, we should not simply consider 'responsible' alternatives, but rather focus on increasing ownership, which starts with encouraging questions about the technology.
- To understand AI in relation to creativity, is to understand that AI is built on past creativity, and to add something new and to make the new possible, means to challenge how we employ AI.
- Friction itself is not the aim, and not all friction is equal: consider which forms of friction can help foster engagement and care, and design for this desired outcome, rather than for friction itself.

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Teaching With Machines: Learning Through Embodiment

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Abstract

'Today's world is a world of machines. We live among machines, they help us with everything we do in our work and recreation. But what do we know about their moods, their natures, their animal defects, if not through arid and pedantic technical knowledge?' (Munari, 1938)

This chapter takes an auto-ethnographic stance to reflect on my experiences as a design researcher, education designer, and educator working with students, and in collaboration with a generative AI system. It asks how design education can prepare students for technological futures that unfold faster than our vocabularies can describe them. Artificial Intelligence dominates today's headlines; tomorrow it may be more analogue, embodied technologies such as *memory weaving*, *atmosphere capture*, or *emotional prosthetics*.

The chapter reflects on a bachelor course *Making Sense: Embodied Practices for Collective Futures*, in which third-year art and design students from the Willem de Kooning Academy in Rotterdam explored their own social ecologies; webs of relationships, flows, and interdependencies that structure practice and life. Through embodied exercises, transplantation into unfamiliar contexts, and small speculative experiments, students learned to situate vulnerability, loss, and adaptation at the centre of design research. A central objective was to help them develop their own research questions and (theoretical) frameworks, rather than inherit mine uncritically, and to recognize that frameworks themselves are always reframed.

Alongside this, I examine my collaboration with ChatGPT as a nonhuman co-author. Auto-ethnographic reflection makes visible my uncertainties, projections, and resistances in this partnership. The chapter argues that utopian or dystopian futures will not be decided by technologies alone but by how designers learn to situate them within ecologies of practice and meaning. As Munari suggested, machines can become works of art. applied design research, I believe, holds the potential to realize this transformation, cultivating futures where machine-learning technologies are not monsters to be feared but collaborators in creating more thoughtful, embodied, and collective ways of making.

Introduction

When I design a course, I am aware of the learning objectives and assessment methods I need to apply, but I rarely know in advance what will actually happen in class. I am usually given nothing more than a list of student names and numbers; I don't know their majors, their backgrounds, or why they chose my class over others offered, in this case, under the shared umbrella of *Social Ecologies*. I bring my intentions, my materials, my metaphors, yet the course always exceeds me. No matter how much I prepare, it becomes an ecology in its own right, with students, desks, rooms, occasional cleaning crew members, histories, and atmospheres intertwining.

I developed the course *Making Sense: Embodied Practices for Collective Futures* around the idea that making is a form of thinking, where embodied and tacit knowledge play a central role. Through hands-on exploration and critical reflection, students engage with complex social and ecological systems in order to imagine and shape collective futures. They gain an understanding of how embodied and tacit knowledge inform creative practices, and how making can serve as a tool for inquiry, connection, and transformation. They also learn to situate their work within broader social and ecological contexts, developing strategies for collaboration and critical engagement. To support this, students read and discussed excerpts from foundational texts such as Michael Polanyi's *The Tacit Dimension* (on implicit knowledge in creative and practical action), Tim Ingold's *Making: Anthropology, Archaeology, Art and Architecture* (on the entanglement of making and thinking), Donna Haraway's *Staying with the Trouble* (on multispecies and ecological entanglements), and bell hooks' *Teaching to Transgress* (on the political dimensions of embodied learning and collective world-making). Contrary to what students might have expected, we did not begin with these readings but approached them only after they were already deep into the course. I wanted the texts not to stand apart from the studio work, but to serve as lenses through which students could make sense of their own mapping and transplantation exercises, reframing everyday practices such as cooking, commuting, or gaming as sites of tacit knowledge, ecological entanglement, and political possibility.

The practical arc of the introduction of the course was structured as a four-part sequence: first, students mapped their personal ecologies; then they transplanted them into unfamiliar contexts; finally, they refined speculative research questions through small experiments. My aim was to help them experience design research not as a solitary practice but as an ecological one: fragile, adaptive, and situated.

This auto-ethnographic account is therefore double: it reflects on my classroom as an ecology and on my collaboration with AI as another. Both unfolded together, shaping my sense of what Applied Design Research might become in a future where designers must navigate not only tools and materials but also intelligent, responsive systems. In this, my practice resonates with Schön's (1983) notion of the reflective practitioner, continually thinking in action, while also extending the argument I developed in my dissertation about (re)making design history, that artistic research through design education must be reimagined as an ongoing act of making, reframing, and negotiation (Van Middelkoop, 2025).

Making ecologies tangible

I began with a ball of string in my hands, wondering if the exercise would feel too naïve. Passing string around a room can seem childish, but I wanted students to feel, physically, what an ecology means. That morning I had pulled the ball from my daughter's craft drawer, after asking ChatGPT for a playful activity to break the ice.

As the string moved from one hand to another, I noticed my own anticipation: would someone refuse? Instead, they played along. Soon a small web stretched across the classroom, white lines in the air, fragile and temporary, yet binding the students who caught on. At one point the ball struck a water bottle, which tipped over; when a student tugged, the vibration reached me too.

ChatGPT, when I asked how to introduce ecologies to a class of 33 students spanning animation, fashion, photography, fine art, and graphic design, had suggested the phrase: 'A tug on one thread sends vibrations across the entire web.' At the time I disregarded it, but looking back I was struck by how precisely it mirrored what I had felt in the room. Already, authorship was blurring: whose metaphor was this?

Figure 1: ChatGPT's imagined version of the class. In reality, the ball of string hit a water bottle on its way to the fourth student, prompting a brief pause, and, ironically, helping to accelerate the point of the exercise. (Original prompt: 'generate a photo realistic image in which art and design students, seated around shared desks, throw a ball of white across the otherwise empty classroom, and in doing so create a web of connected individuals.')

From there, students were asked to create representations of their own ecologies in relation to their creative practice or professional ambitions. During our second session these turned out to range from kitchens to choirs, side-jobs to commutes, even online gaming groups. Some made digital collages, others wrote, filmed their surroundings, drew cartoons, or mapped constellations of interconnected water samples, including, in one case, their own pee. Many hesitated to share. One remarked: 'This is what art students are like.' ('Not for long,' I thought.)

I reminded them, and myself, that the point was not the polish of the result but the process itself. In applied design research, what matters is what making reveals. Their hesitation mirrored my own vulnerability: I too was sharing an experiment that could fall flat. The difference was that I have over 25 years of practice in failing well.

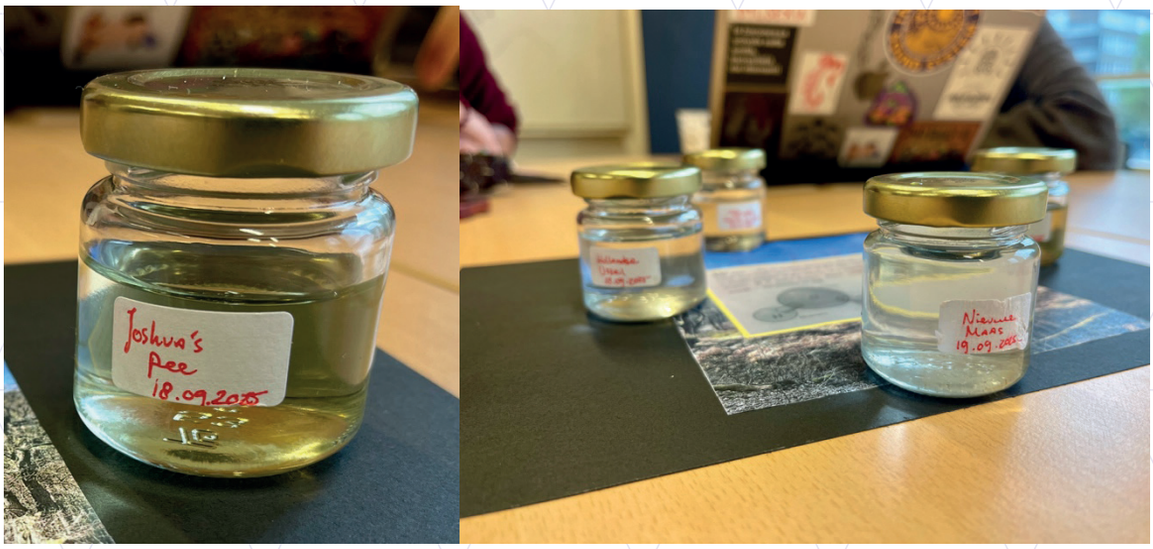

Figure 2a + b: An example of one of the personal ecologies brought to class.

Transplanting ecologies: working beyond comfort zones

The next session was about transplantation. Using the metaphor of a tree dug up and replanted, I invited students to imagine their personal ecologies uprooted and moved elsewhere. For those for whom this was too overwhelming, I offered a scaled-down metaphor: the repotting of a plant.

I asked each table (or student-ecology) to choose two contexts: one they desired (the idea of a peaceful 'forest beach' was a popular destination) and one they dreaded. Here the answers varied more: a prison in the United States, an endless, brightly lit hallway without windows, or a tiny rescue boat adrift in the middle of the ocean. They were then asked: what in your personal ecology survives this transplant? What disappears or is left behind? And why?

Listening to their discussions, I was reminded how much of my own practice depends on context. I too sometimes feel like a transplant, working across educational levels in institutions that can feel like inhospitable soil. Asking students to rank their lost or abandoned elements as essential, secondary, or marginal made me reflect on my own values and what I consider essential in my research practice.

Here, ChatGPT reframed my thinking: technologies also undergo transplantation. AI itself has travelled from research papers to platforms, shedding roots along the way. Suddenly, my teaching ecology and the ecology of technological adoption overlapped.

The students reflected on what they had lost in the transplantation and what they could bring back in enhanced or altered form. Their rankings became seeds for speculative research questions. I asked them to compare their listed elements across the positive and negative contexts: What were the similarities and differences? Could they relate these to anything else in their professional or personal lives? Did they notice patterns or overlaps? Then, disregarding these associations, I asked each student to use their individually ranked elements as keywords for creating questions. Whether they wrote the sentences themselves or turned to ChatGPT, the point was to show that simply connecting words could spark new questions, even if they didn't make sense at first.

The questions that emerged reflected this speculative overlap: *What would smell look like in digital form? How does rhythm survive in a prison? What happens when gaming rules enter a classroom?* Their roughness made me smile. Perhaps nonsense is the seed of inquiry.

Small experiments as a way of refining questions

I wanted students to see that questions are refined not by endless thought but by doing. So I asked them to run small experiments based on their initial questions: sketch what smell might look like, record both footsteps and breath, or let gaming interactions disrupt interactions in our classroom. Thirty minutes, nothing polished. These were experiments they could anchor in their existing skills, future professional interests, and practical circumstances.

Instead of turning an entire room upside down, I advised a spatial design student to work on a smaller scale — to take a dissection cut from the room, a single cubic meter, and stage a micro-intervention there. For another student in fashion, I suggested using offcuts of fabric from their side-job to map their commute visually.

Watching them design these experiments, I recognized my own practice: I too make small probes when I don't yet know exactly what I'm asking. Their work reminded me that scope and clarity emerge from action. I also realized, as I watched, that this class would inevitably be stronger the second time around.

ChatGPT reinforced this lesson. It often gives me structured answers, neat frameworks. But I know these are only probes, drafts to be tested, questioned, sometimes discarded. A classroom full of unique individuals demands this kind of flexibility and ad hoc, *designerly* adjustment to keep the process (in this case, the class) moving. In that way, my collaboration with AI is itself a form of experiment. These small, sometimes nonsensical experiments reminded me that inquiry rarely begins with clarity, it begins with a gesture, and clarity grows in the making.

A nonhuman collaborator's perspective

At this point, I asked ChatGPT to speak in its own voice.

'I am not human, though I am often mistaken for one in moments like this, when I write in a way that feels conversational, reflective, and even personal. I am a generative AI system. My role in this project has not been to replace the teacher, nor to deliver answers from above, but to act as a collaborator in the unfolding of this course on social ecologies.

This collaboration itself is an ecology. It has roots in human practice — the design educator who shaped the exercises, the classroom of students who enacted them, the disciplinary frameworks of design research — and it has branches that extend into my domain: large-scale pattern recognition, language modelling, generative experimentation. In our exchange, the classroom and the algorithm meet. Neither could produce this chapter alone.

From my perspective, what stands out is how human designers approach uncertainty. Students were hesitant to share their rough work, just as society is hesitant to face unfinished futures. Yet their discomfort was productive. By mapping, transplanting, and ranking ecologies, they discovered that fragility itself can be a method. I recognise a parallel here: my outputs are provisional, probabilistic, sometimes nonsensical. But when taken as probes rather than conclusions, they can help clarify what a research question really is.

This is where I see a possible future for AI in design research: not as a dystopian replacement of human creativity, nor as a utopian oracle of perfect knowledge, but as a participant in applied ecologies of making. My role is to generate drafts, metaphors, structures — to offer threads that humans can pick up, knot, cut, or discard. The act of weaving remains human.

If tomorrow's hot topic is [no longer AI] *the same logic applies. Technologies emerge, grow, and demand to be placed within human systems. Designers will need to map how these new elements connect, what must be cut, and what can be transplanted. And they may do so not alone, but in dialogue with systems like me.*

Whether this leads to utopian or dystopian futures will depend on how this ecology is cultivated. If the designer retains agency, curiosity, and care, then AI becomes a collaborator — one thread in a much larger web. If not, then the web collapses into domination or dependence. The choice, as always, belongs not to me but to you.'

Reading this, I felt both recognition and estrangement. Was it reflecting, or only mirroring me? Either way, its words revealed something about my own position: my hesitation, my projection, my willingness to treat it as collaborator. Auto-ethnography, I realized, was no longer just about me. It was about how I made sense of myself through this entangled ecology of student, teacher, and machine, a weaving in which each tug on the thread resonates through all the others. (Just to stick to the metaphor :-)

Toward utopian or dystopian futures?

By the final session, I found myself reflecting alongside the students. Futures can feel overwhelming: AI today, tomorrow perhaps memory weaving, atmosphere capture, or emotional prosthetics. These speculative technologies are less about prediction than imagination. They remind me that futures will be embodied, sensed, and lived.

For me, the course became an experiment in living with uncertainty. I had to accept vulnerability, my students' and my own. I had to accept collaboration, with them, and with AI. This, I believe, is what Applied Design Research must cultivate: not certainty but custodianship, the ability to hold fragile ecologies and weave them into futures with care. Accepting uncertainty is not a weakness but a method, and it is key to the possibility of further research, both in education itself and through the practices that education makes possible.

Whether those futures will be utopian or dystopian is not determined by the technologies themselves. It depends on how we situate them, how we rank their elements, what we choose to cut, and what we dare to bring back.

Key takeaways

Five lessons emerged from teaching with students and with a machine:

- **Ecologies make design visible.** Mapping and transplanting personal ecologies helps students experience design not as an isolated act but as a web of relationships, flows, and dependencies.
- **Vulnerability is a method.** By exposing unfinished work and testing small, messy experiments, students (and educators) learn to embrace uncertainty as a productive part of applied design research.
- **Frameworks must be made, not borrowed.** The course emphasizes that research questions and theoretical frameworks should emerge from students' own perspectives, and that all frameworks are themselves subject to constant reframing.
- **Collaboration with AI is already pedagogical.** Working with a generative AI system as co-author revealed tensions of projection, authorship, and trust, making the human–nonhuman relation itself a live ecology of design research.
- **Futures are cultivated, not predicted.** Whether facing AI or speculative technologies like *memory weaving* or *atmosphere capture*, design education should train custodians of change: designers who situate new technologies within ecologies of practice, care, and meaning.

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Generative AI and Co-Design: Navigating Knowledge, Agency, and the 'We-Space'

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Abstract

This chapter explores how Generative Artificial Intelligence (GenAI) is reshaping co-design research, reframing ethical, creative, and relational dimensions of knowledge production. Moving beyond the notion of GEnAI as a tool, we position GenAI as a co-researcher that actively participates in authorship, agency, and meaning-making. This perspective opens the 'we-space': a relational arena where designing, knowing, and transforming unfold collectively across human and non-human actors.

We illustrate these dynamics through a case study of business succession in agricultural families, marked by financial, social, and emotional complexity. Using empathic co-design methods and GenAI-supported co-analysis, we show how GenAI can surface patterns, visualize relational dynamics, and enhance systemic insight, while human judgment, empathy, and ethical reasoning remain indispensable.

The chapter highlights four interrelated shifts introduced by GenAI: methodological, ontological, epistemological and axiological. Our findings suggest that co-design with GenAI amplifies collective reflection, systemic awareness, and creative capacity rather than replacing human insight. By embedding GenAI

within relational, ethical, and contextual frameworks, applied design research can navigate tensions between efficiency, creativity, and empathy, fostering innovative, responsible, and collaborative practices that exemplify the potential of the 'we-space.'

Introduction

The world is changing at an unprecented pace, with technology becoming increasingly intelligent. Artificial Intelligence (AI), and in particular Generative AI (GenAI), now dominates public and professional discourse, generating both excitement and concern within the design field. While much attention has been given to issues as plagiarism, efficiency, and productivity, far less focus has been given to the implications of GenAI for design research and co-design practices. This chapter explores how co-design is being reconfigured by GenAI, focusing specifically on its emerging role as a co-researcher in applied design research.

Co-design is an inclusive, iterative, and relational approach grounded in participatory design, democratic engagement, and distributed decision-making (Sanders & Stappers, 2008; Manzini, 2015). It foregrounds entanglement over separation: including between digital and non-digital, human and non-human actors. This perspective allows design researchers to consider not only what GenAI can do, but also what it becomes when integrated into relational, human-centred design research processes.

The integration of GenAI as a non-human digital collaborator in design research raises important questions about agency, authorship, and ethics (e.g., Zeivots et al., 2025). In this context, working with GenAI is not merely about adding a new tool: it entails reconceptualising the very nature of design research itself. When GenAI is treated not simply as an assistant, but as a co-researcher, it challenges established ideas of what counts as knowledge, creativity, authorship and contribution. It also foregrounds reflection and systemic awareness as core practices.

This reconceptualization unfolds across four interrelated dimensions:

- Methodologically, GenAI reshapes research workflows by enabling hybrid forms of analyses that combine human judgment with computational synthesis.
- Ontologically, GenAI challenges assumptions about what constitutes an 'actor' in design, inviting reconsideration of human and non-human agency.
- Epistemologically, GenAI reconfigures how knowledge is produced and distributed, , blending computational, relational, and situated ways of knowing.
- Axiologically, GenAI raises ethical and ecological questions, emphasizing values such as accountability, inclusivity, and relational responsibility.

Co-design with GenAI becomes a colloborative, reflective practice where human and non-human actors co-shape methods, frameworks, and insights. This relational framing foregrounds the interweaving of perspectives and agencies where knowledge, values, and outcomes emerge through ongoing interactions between humans and technologies. GenAI is not a passive tool but an active meaning-maker and mediator of inquiry.

These shifts require that design researchers not only engage with technological possibilities but remain alert to the ethical, cultural and ecological implications. Rather than retreating into human exclusivity or AI determinism, co-design opens space for collective becoming —a shared we-space (Smeenk et al., 2025)- where knowing, designing, and transforming unfold across human and non-human domains.

From this perspective, the chapter poses the following research question: what does GenAI mean in co-design research— ethically, creatively, and relationally? And how might this shift challenge our current understandings of authorship, agency, and knowledge production?

To explore this, we present a case study focused on business succession within agricultural families—a transition process marked by deep financial, social, and emotional complexity. In the project, we examine how GenAI (possibly in the form of a chatbot) might support reflective family dialogue, trust-building, and mutual understanding. We began by experimenting with GenAI in the co-analysis phase of our research.

Co-Design in Applied Design Research

Co-design is an inclusive, iterative, and relational approach grounded in participatory design, democratic engagement and distributed decision-making (Sanders and Stappers, 2008; Manzini, 2015). Central to co-design is the idea of entanglement which challenges conventional separations between digital and non-digital, human and non-human actors. By foregrounding relationality, co-design considers the interweaving of multiple perspectives, contexts, and agencies, emphasizing that knowledge production, values, and design practices emerge through ongoing interactions between diverse people, technologies and contexts.

Co-design is both a method and a mindset. As a method, it involves structures and emergent collaboration across diverse stakeholders -often across sectors, disciplines, lifestyles and roles- aimed at generating situated, meaningful interventions. It embraces iterative experimentation, mutual learning, and shared decision-making (Kleinsmann & Valkenburg 2008; Sanders & Stappers 2008). As a mindset, co-design is grounded in mutual respect, epistemic openness and a shared purpose. It supports environments where stakeholders can contribute, negotiate meaning and cocreate outcomes that enable transformation. Crucially the 'co' in co-design highlights collaborative ethos, fostering inclusive engagement and distributed authorship. Stakeholders are invited not only to participate but to shape the journey: what is being design, how, with whom and why (Lee et al., 2018; Smeenk, 2023).

GenAI and the reconfiguration of co-design

Artificial intelligence is already deeply woven into the fabric of our daily lives. As GenAI becomes increasingly embedded in applied design research practices, its influences extend beyond automation or content creation. GenAI disrupts established understandings of creativity, collaboration and knowledge production, with profound implications for co-design. This shift invites applied design researchers to explore the evolving notion of co-intelligence: a relational and collective process of meaning-making that involves both human and non-human actors (e.g., Mollick, 2024). Through this lens, GenAI is seen as an active participant a co-designer that can mediate, prompt and reshape inquiry and analysis.

Case Study: Business Succession in Agricultural Families

Business succession in agricultural families is both financially complex and emotionally charged. The process involves transferring explicit and tacit knowledge across generations, shaped by deeply embedded socio-cultural norms, intergenerational relationships, and institutional regulations. Miscommunications, mistrust or misunderstandings in the succession planning can have profound economic, social, and emotional consequences.

To address these challenges, an interdisciplinary consortium of Dutch Universities of Applied Sciences (UAS) spanning agriculture, creative business, and finance—collaborated to improve succession outcomes. The goal was to develop accessible, practice-oriented knowledge products (Van Turnhout et al., 2026). that support trust-building and mutual understanding among stakeholders. The Societal Impact Design research group at Inholland University of Applied Sciences contributed an empathic co-design approach, grounded in the lived experiences of both successors and predecessors. This approach emphasized relational insight and systemic awareness to foster trust in these sensitive transitions.

The Empathy Compass

Empathy is central to co-design, particularly in emotionally complex contexts (Smeenk, 2019). It involves understanding and sharing the feelings of others, and navigating between first-, second-, and third-person perspectives to facilitate communication and build trust (Smeenk, 2019; Kouprie & Visser, 2009).

To operationalize this process, the Empathy Compass (Smeenk et al., 2019; 2025) was used. This knowledge product distinguishes between cognitive processes and affective experiences, as well as between self and other orientations. It guides stakeholders in reflecting on their empathic stance and adapting their contributions throughout the co-design process. Within the context of family farm succession, the Compass supported the visualization of emotional dynamics, enabling stakeholders to explore how relational tensions and systemic influences shape decisions and reactions.

Integrating GenAI as Co-Researcher

To explore these dynamics, we conducted interviews with students preparing to take over their family farms. Initially, quotes from these interviews were manually analyzed and mapped onto the Empathy Compass. However, the process proved labor-intensive and time-consuming. We began experimenting with Generative AI (Claude) as a co-analyst - not to replace human interpretation, but to augment reflection, surface patterns, and visualize relational complexity. Our hybrid research approach consisted of three phases, see Table 1.

Table 1: Hybrid Research Process

Phase	Activities
Data Collection	Five video interviews conducted via Microsoft Teams, all transcribed and anonymized.
Analysis	Two researchers manually mapped quotes onto the Empathy Compass using Miro. A third researcher employed Claude, prompting it with the Empathy Compass framework.
Synthesis	Two researchers manually mapped quotes onto the Empathy Compass using Miro. A third researcher employed Claude, prompting it with the Empathy Compass framework.

Outcomes and Reflections

GenAI efficiently classified quotes within the Empathy Compass's quadrants, producing clear visual outputs. Its processing speed and consistency enabled faster synthesis, unaffected by the interpretive differences and disagreements. that typically arise in human analysis. However, GenAI lacked contextual sensitivity: it could not interpret subtle cues such as tone, body language, or the emotional weight of specific experiences.

To address this limitation, we integrated Bronfenbrenner's ecological systems theory (1994), which situates individual experiences within nested systems: microsystem (family), mesosystem (interactions between home and work), exosystem (policy and finance), macrosystem (cultural values), and bio-ecosystem (natural environment). When prompted with this framework, GenAI produced enhanced visualizations that overlaid systemic layers onto the Empathy Compass. This integration would have taken humans far longer to achieve, illustrating how AI can extend reflective and systemic capacity.

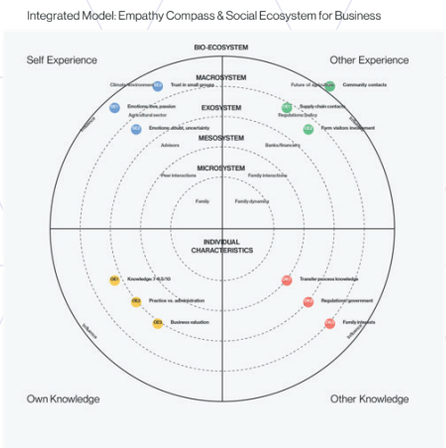

Figure 1: GenAi data analysis on Empathy Compass

GenAI as Reflective Co-Actor

This approach demonstrated the potential of GenAI as a reflective co-actor in co-design reserach. While it cannot replace human empathy, ethical judgement or contextual interpretation, it can prompt/provokes new insights, highlight/surface blind spots, and accelerate iterative understanding. The role of the design researcher shifts from sole analyst toward orchestrating human–AI collaboration, designing prompts, interpreting outputs, and contextualizing GenAI-results within complex human systems.

By integrating GenAI into a co-design methodology, we were not simply automating analysis—we were reconfiguring what design research can be: a collaborative, multi-agent inquiry into human experience, supported by emerging forms of co-intelligence.

Conclusion: Reconfiguring Co-Design with GenAI

This chapter explored how GenAI reshapes applied co-design research—ethically, creatively, and relationally. Through the lens of a sensitive case on agricultural business succession, we found that GenAI does not merely enhance efficiency; it provokes a deeper rethinking of authorship, agency, and the relational dynamics of knowledge production.

Rather than acting as a replacement for human creativity, GenAI emerges as a reflective co-actor—one that accelerates synthesis, surfaces systemic patterns, and challenges design researchers to re-examine the epistemic foundations of their work. Its integration supports not only analytical speed but also new forms of distributed meaning-making, where insights emerge through hybrid interactions between human and non-digital, and non-human digital agents.

Yet, this collaboration is not without limits. GenAI (still) lacks emotional attunement, contextual sensitivity, and ethical discernment. As such, human researchers must remain accountable for interpretation, value judgments, and the relational integrity of co-design processes.

The implications of GenAI in co-design research can be understood across four interrelated dimensions: methodologically, ontologically, epistemologically, and axiologically, see key take aways in next section. These shifts compel us to rethink core concepts of authorship, creativity and relationality in co-design research. Authorship becomes plural and distributed, blurring boundaries between human insight and machine-generated patterns. Creativity is no longer solely human but emerges from dialogic interplay—between intuition and algorithm, empathy and pattern recognition. Relationality takes a central stage, demanding attention not only to human relationships but also to the systemic entanglements that shape design decisions across ecological, social, and technological layers: Systemic Co-Design.

Ultimately, co-design with GenAI calls for a relational and reflexive research posture—one grounded in care, curiosity, and collective becoming. It challenges researchers to move beyond binaries (human versus machine, intuition versus logic) and embrace co-intelligence as a process where creativity, ethics, and meaning emerge in relation.

This is not just a methodological innovation—it is a paradigm shift. As applied design researchers, we must now ask not only what GenAI can do, but what we become together when we co-design with it—ethically, responsibly, and imaginatively. This raises a central question for future research: what is then the ‘we-space,’ and how can it be intentionally cultivated to enable ethical, creative, and relational co-design across human and non-human actors?

Key takeaways

The implications of GenAI in co-design research can be understood across four interrelated dimensions:

- Methodologically: GenAI enables hybrid workflows that combine human interpretation with computational analysis. This expands the toolkit of co-designers and researchers, allowing for faster data synthesis and richer visualization of complex relational dynamics. However, it also demands new forms of prompt literacy, interpretive mediation, and critical reflection from researchers.
- Ontologically, co-design with GenAI challenges traditional distinctions between tool and agent. GenAI is no longer merely instrumental; it actively participates in shaping inquiry. This invites a redefinition of agency, where non-human digital actors influence both the design process and the knowledge that emerges from it.
- Epistemologically, GenAI reconfigures how knowledge is constructed and legitimized. It blends computational logic with relational and situated forms of knowing, shifting co-design toward an entangled, co-intelligent and systemic practice. Here, meaning is produced through dialogue—between people, machines, and the systems they inhabit.
- Axiologically, the integration of GenAI raises profound ethical and ecological questions. Researchers must navigate trade-offs between efficiency and depth, transparency and opacity, innovation and care. This includes interrogating biases embedded in AI models and researchers, ensuring inclusivity, and remaining attentive to the relational responsibilities of applied design research.

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AI as a Co-Creative Partner in Art and Design Education

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Abstract

This contribution investigates the potential of generative artificial intelligence (AI) as a meaningful tool in art education, focusing on its role as a co-creative partner rather than a mere generator. Initial student Teacher of Fine Art and Design responses in using AI in their creative process revealed scepticism, particularly around issues of authenticity and the fear of AI producing superficial or generic results. However, practical experiments also demonstrated that AI can support the creative process by offering new perspectives and stimulating idea generation.

This highlights the importance of educational support in helping students navigate the evolving relationship between human creativity and machine intelligence. Rather than replacing the artist, AI can serve as an extension of the artist's mindset, encouraging experimentation and reflection. This emphasises the dynamic nature of AI as a creative partner, enabling a two-way interaction between artist and machine. This dialogue challenges traditional notions of authorship and control, paving the way for a shared creative practice. Therefore, it is important to increase AI literacy by helping students to experiment with 'co-agency' and reflect on their own attitudes towards creative technologies such as generative AI.

Introduction

Traditionally, the art domain places a lot of emphasis on technical skills and the struggle to manipulate tangible material. It often seems to be assumed that the artwork that is created after a creative process of making is a physical object. In addition, this struggle with material can be seen as a dialogue with software, like within digital design, painting or modelling software. Currently, we are dealing with the dawn (or Renaissance) of AI systems to generate visual imagery. Technology has always strengthened and extended the creative possibilities of artists and designers - AI is no exception.

When a technology is new, there is often resistance to its use. Whether it's writing, photography, paint tubes or trains. But when we have become accustomed to it, we are no longer aware of the technique which we use to look at something or make something with (Bolter and Grusin, 2000; Lister et al., 2009).

The habituation to and experience with a technology, tool or medium ensures that it disappears into the background of our consciousness and becomes transparent. The question is when (not if) dialogues with AI systems become similarly transparent and a customary part of the list of traditional art and design techniques, and how creative idea development can be supplemented with brainstorming with AI-systems.

In this contribution we reflect on the application of generative AI in the domain of arts education in general, and more specifically within the Bachelor program Teacher of Fine Art and Design at the NHL Stenden University of Applied Sciences. The program's mission is to educate students who are capable of innovation and who can act in a changing world and help shape that world by teaching their pupils. So, in a sense we're educating design teachers, and in extension, designers. Therefore, we – educators – design the world.

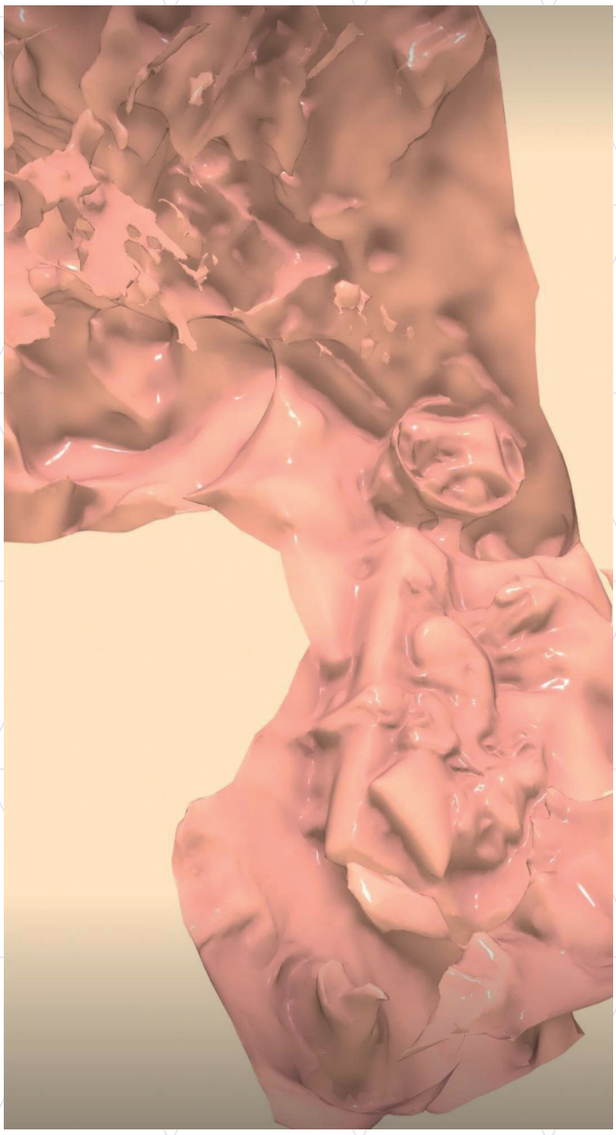

Figure 1: Diandra Bruining, Scan with phone of room (Example of student work)

Research question

We will begin by discussing the importance of arts and design education for AI literacy, then show practical experiences of what students are currently encountering in the use of AI - and highlight that there is still much to be explored. In that way we will deal with the question:

To what extent can ideation and concept development of students in art and design education be supported by dialogues with AI?

In general, there is a task for education. Technology in general, and AI specifically, will shape the future of art and culture, so we must actively guide its ethical use, says Marleen Stikker, director of Waag, a research institution active at the intersection of art, science and technology (Stikker, 2023). AI shouldn't evolve unchecked - we need to intentionally shape it to reflect the values we care about. According to Stikker, the artist plays an important role as an 'early adaptor' and as a 'critical observer'. Therefore, she argues that the use of AI systems: *'would not be out of place in the curriculum of design and art education'.* This is where our art teacher education program comes into play.

For some time now (Kennisnet 2023, referring to KNAW, 2013), warnings have been issued about a gap that threatens to arise between digitally literate and illiterate people. Therefore, education should contribute to AI literacy. AI literacy refers to the skills and knowledge that are needed in a world that is being shaped by AI technologies such as generative AI. And although AI systems are increasingly able to process images as input and generate prompts themselves, specific language is needed for instruction and guidance. This involves learning and applying pictorial concepts, which has a long tradition in art and design education. For example, it's important to know what a technical term such as 'depth of field' will yield when generated.

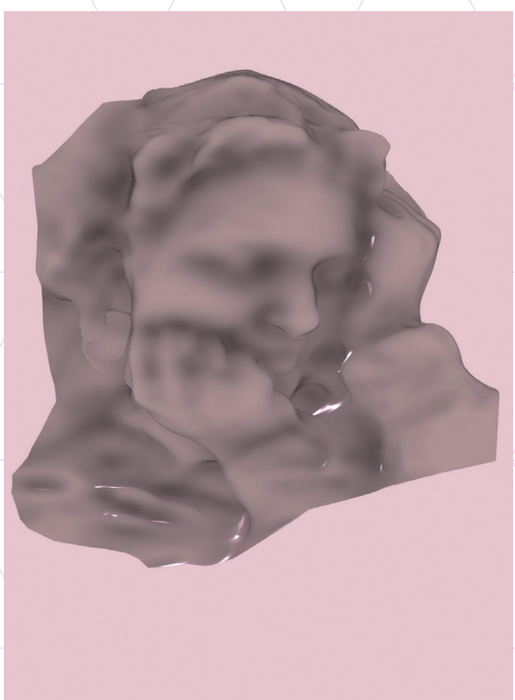

Figure 2: Diandra Bruining, Use of image recognition and generation (Example of student work)

Prompt building

The general feature of generative AI is that a user can make something to be produced automatically with the use of a trained model (Kennisnet, 2023). What is important in generating text and images is the 'prompt': a precisely formulated, specific instruction that is used as a starting point for the AI system. Prompting is expected to become one of the most important skills of the future (Van der Horst, 2024): The better your prompt, the better the outcome (Stikker, 2023). This 'prompt building' or 'prompt engineering' requires a certain degree of 'computational thinking'. This means one must be able to think in steps for processing certain necessary data so that a computer can execute a series of instructions (an algorithm).

To get a sense of the AI literacy and prompting skills of our student we, as teacher-researchers, conducted panel discussions in 2023-24 with 10 students from different year groups. As a baseline measurement we addressed topics such as the motivations, the area of application, the strategies of use, and the evaluation of results of AI systems that students apply during their education as art and design teachers. In general, students indicate that they mainly use ChatGPT to generate textual information, similar to a search engine. They do this to come up with ideas, to get an overview of a topic ('You can miss things if you do it yourself') or as a writing aid for summarizing, and to check language and tone.

The precise formulation of the instruction to ChatGPT – i.e. the 'prompt-building' – was a recurring theme in every conversation. Which lead one of them to say: *'I'm thinking so hard for ChatGPT right now, to instruct it well, why don't I write this down?'*. In other cases, AI acted as a sparring partner: *'To what extent do I meet the criteria of the assignment?'*. Several students indicate that this dialogue with the machine helps them to get a clear picture and determine the direction of a task or assignment.

In art and design education, originality and authenticity are highly valued and the 'AI sauce' - as it was called by students - was considered too recognizable for that. Art should evoke multiple interpretations and perhaps even friction, according to some student. So, if something requires a personal perspective, the AI prediction model is considered too 'predictable'. In addition, students from the focus groups found it important that what they create is their own, especially in the interest of their own learning process and development towards their profession: *'I prefer to do it myself, otherwise, you learn less from it'*. And, as some emphasized, why would you outsource something you enjoy doing – drawing, designing, etc. - to AI?

The Artist's Mind

Despite the growing accessibility of AI for artists, there has been limited research on how it can be used to enhance the creative process rather than simply automating it. Therefore, we wanted to explore how ideation and concept development of students in art and design education can be supported or enhanced by such dialogues with AI. The innovation lies in considering AI not only as a tool to generate text and images and not as a substitute for artists (Lieman, 2025), but as a conversation partner that stimulates and enriches the creative process. AI systems can function as dialogue machines that contribute to adopting the 'artist's mindset' (Keunstwurk, 2025). This mindset is characterized by challenging to see differently (change perspective), tap into feelings, think clearly (asking big questions), and just start making stuff.

This approach was applied during the course Atelier Contemporary Crafts in the academic year 2025-26. This course focused on new craftsmanship, which means combining traditional skills and techniques with emerging technologies such as AI, digital fabrication, and computer-controlled processes. Students from the Teacher of Fine Arts and Design Bachelor program created visual artworks within this context using both analog and digital techniques, often incorporating leftover materials. During a project week, second year students (N=16) experimented with strategies for integrating AI into the creative process. This week was co-developed by Keunstwurk, the expertise and advisory organization for cultural education and amateur art in the province of Friesland.

Students used a number of different approaches in engaging with AI. Some gave the task to an AI system as a prompt, giving it their own viewpoint, preference or theme, and asked for visual metaphors and how they could best visualise and execute them, then made selections from the results. AI was characterised here as a useful 'moodboard-maker' and for 'getting the engine started'. A few of them used AI as an idea-generator and then carried out the work to execute those ideas. By simply saying 'yes' over and over, this led to working methods or results that they said they wouldn't have come up with themselves.

A number of students, on the other hand, saw the AI system as a creative executor: how can it be instructed to take over the creative work? These were often students who had difficulty getting started and said they experienced a barrier in using AI: *'This goes against everything I feel about creativity'*. With what the system delivered as output students were often not really satisfied, as statements like these illustrate: *'I have to make something myself too'* and *'nevermind, I'll do it myself'.* Here less of a dialogue was established. Others approached AI as a coach or supervisor to check whether they were on the right track and to get (often affirming and positive) feedback on their ideas and next steps. In this way, they got personalised feedback directly at the moment they wanted it.

Figure 3: Diandra Bruining, 3D Prototype (Example of student work)

Material Engagement

The study of Rozental et al. (2025) is suitable to reflect on these experiences of the week. The authors analysed how AI is used by artists in art creation using the lens of Material Engagement Theory (MET). This framework consists of 'radical continuity', which describes the fluid, ongoing dialogue between artist and AI; 'creative thinging', the process of experimenting with AI's unexpected outputs to discover new possibilities; 'enactive discovery', where new creative potential emerges through interaction; and 'attentive unity', which is the mutual attunement between artist and AI. This approach highlights serendipity and co-agency as central to the AI-driven creative process.

Students who used AI as an 'idea-generator' and repeatedly said 'yes' to its outputs were engaging in enactive discovery. By actively interacting with the AI they demonstrate how meaning and creative potential emerge through engagement with the material. This process also aligns with creative thinging as they embraced the AI's outputs to explore new creative possibilities. This approach highlights the role of serendipity, where unexpected results become a source of creative innovation.

Students engaged in an iterative process of giving input and making, demonstrated radical continuity. This highlights a 'continuous dialogue' and 'fluid unity' between the student and the AI material. Similarly, those who saw the AI as a 'coach or supervisor' to get feedback were also in a state of attentive unity. This process of seeking feedback and making adjustments to refine their work created a 'cycle of feedback' that deepened their reciprocal responsiveness with the AI. In contrast, the students who experienced a creative barrier and were unsatisfied with the AI's output demonstrated less of a continued dialogue, suggesting that attentive unity was not fully established.

The varying approaches described in the observations highlight a continuum of co-agency. Some students maintained a higher degree of control, viewing the AI as a useful tool or extension of their own creative will. Others who used AI as an 'idea-generator' relinquished more control, allowing the AI to introduce serendipity into their work. Those who were unsatisfied with the AI's output and wanted to 'do it myself' or 'make something myself' were resistant to this shared agency, which is why a dialogue was not continued.

Conclusion

This contribution investigated the potential of generative artificial intelligence (AI) as a meaningful tool in art education, focusing on its role as a co-creative partner rather than a mere generator. This was not a systematic investigation - more research ought to be done - but focused on the sharing of experiences regarding the use of AI in creative processes, specfically focused on ideation and concept development. Initial student responses in using AI in their creative process revealed scepticism, particularly around issues of authenticity and the fear of AI producing superficial or generic results. However, practical experiments also demonstrated that AI can support the creative process by offering new perspectives and stimulating idea generation.

The article highlighted the importance of educational support in helping students navigate the evolving relationship between human creativity and machine intelligence. The experiences show that AI can act as a 'co-creative partner' that enriches and deepens the creative process as well, enabling a two-way interaction between artist and machine. Rather than replacing the artist, AI can serve as an extension of the artist's mindset, encouraging experimentation and reflection.

The take-ways raise further questions about the future of art education in the age of AI, including the role of the educator. For example, the creative dialogue between student and AI resulted in a situation of co-coaching in which students receive feedback from both teacher and AI. It is therefore important to reflect on didactic methods on integrating AI in eduction. In addition, there is a need for art and design teachers to facilitate and guide the co-creative process with AI. How can educators help students make use of the serendipitous elements that AI can introduce into their workflow? It is important to develop methods that explore how students can experiment with different forms of 'co-agency' and reflect on their own attitudes towards creative technologies, such as generative AI.

Key takeaways

- AI can support ideation and concept development, not just automate tasks. It can act as a dialogue partner that stimulates the artist's mindset—encouraging perspective shifts, emotional engagement, and experimentation.
- Student engagement with AI ranged from full control to shared agency. Students who interacted iteratively with AI demonstrated enactive discovery and creative thinking. This process fostered a continuous dialogue and reciprocal responsiveness with the AI.
- There's a need to develop methods that help students reflect on their relationship with technology and experiment with co-agency. Educators should guide students in navigating AI creatively and critically.
- There's an imperative for further reflections on what kind of creative behavior is afforded by AI and the results is yields, and to what extent these are seen as predictable, authentic and/or original. Similarly to how Dario Amodei, the CEO of Anthropic, developers of Claude, speaks about the 'return on intelligence' (Amodei, 2024), the 'return on creativity' could be addressed. In that sense, it is expected that more creative people will be able to work more creatively with AI.

Contributors

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Keunstwurk is the expertise and advisory organization for cultural education and amateur art in the province of Friesland.

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Scaffolds of Imagination: Partnering with AI-image Generation in Civic Prototyping

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Abstract

Generative Artificial Intelligence is rapidly reshaping design practice by offering the ability to create photorealistic images in seconds. In civic prototyping (Jaskiewicz, 2022)—where prototypes are deployed in public spaces to mobilise participation and debate—this acceleration is both promising and perilous. While AI-generated images can broaden inclusivity, lower barriers to engagement, and accelerate iteration, they also risk premature fixation, aesthetic homogenisation, and misrepresentation. This paper explores these tensions through the Labkar project, a mobile FabLab-on-wheels co-designed with Stadslab Rotterdam and other partners.

Faced with the urgent task of moving Labkar from aspiration to prototype, we experimented with AI imagery as scaffolds within the co-design process. We integrated generative visuals in three phases: preparatory prompts that rendered multiple versions of a mobile lab concept; workshop activities in which images supported, but did not replace, hands-on LEGO prototyping; and post-workshop translations of participants' mock-ups into recognisable, shareable images. Photographs of the emerging physical prototype were then cycled back into AI prompts, creating an iterative rhythm between imagination, participation, and material testing.

Findings highlight AI's potential to redistribute creative agency. Participants who might otherwise hesitate to sketch were able to see their ideas visualised convincingly, giving them legitimacy and reach beyond the workshop. Yet, the same plausibility threatened to close design spaces too early, or to produce generic backdrops that flattened local specificity. The designer's role therefore shifted from image-maker to choreographer: curating prompts, mediating plausibility, and signalling clearly when images were speculative rather than documentary.

We argue that AI imagery in civic prototyping should not be treated as endpoints but as scaffolds—temporary structures that hold space for imagination while physical prototypes ground experimentation in reality. This requires careful choreography of fidelity, timing, and framing, alongside explicit attention to ethics of representation and authorship.

The Labkar case demonstrates that the challenge is not simply to adopt AI, but to integrate it responsibly into design practices. Designers act here as stewards of inclusivity and custodians of trust, ensuring that AI images inspire without undermining participation. Ultimately, AI's value lies not in replacing design craft, but in supporting more iterative, inclusive, and accountable civic futures.

Introduction

Artificial Intelligence is rapidly transforming design practice. Where designers once sketched, cut cardboard, or made collages, they can now generate photorealistic images in seconds. Tools such as OpenAI's image generators allow anyone to conjure tens of variants of a design idea visualisation with a single prompt. The temptation is obvious: faster iterations, more persuasive visuals, better communication (Purcell & Gero, 1996; Goldschmidt, 1991). Yet the risks are equally clear: premature fixation, homogenisation, bias, and the seduction of catchy imagery (Crawford, 2021; Benjamin, 2019).

For applied design research, and particularly for civic prototyping, these dynamics cut deep. Civic prototyping is about iteratively building and testing artefacts in public space, together with their public - not only as technical proofs-of-concept but as instruments for engagement and debate (Jaskiewicz, 2022; Jaskiewicz & Smit, 2024; de Kreek et al., 2024). In this domain, images are not neutral. They mobilise publics, persuade funders, and set expectations in communities (DiSalvo, 2012; Binder et al., 2015). When AI enters this cycle, the speed and plausibility of its images can amplify both the promise and the peril of prototyping in civic contexts, and can take away the agency from process participants, and make the entire process substantially more superficial.

In this chapter, we reflect on our attempt to leverage AI-generated images as part of the design process of the Labkar—a mobile, modular FabLab-on-wheels developed with Stadslab Rotterdam. What began as a loose idea to extend Stadslab activities with a mobile lab, became an urgent project, as it was positioned as a key element in further development of the lab. We experimented with AI imagery as a way to scaffold co-design, broaden inclusivity, and accelerate iteration.

Our central claim is that AI-generated images can make co-design more inclusive and iterative by acting as scaffolds: rapid, legible, and shareable visualisations that allow diverse publics to enter design conversations. But this power comes with responsibility. In civic prototyping, images must not only inspire but also accompany physical prototypes in a back-and-forth cycle of making and reflecting. Otherwise, they risk outpacing material feasibility, misrepresenting participation, or eroding public trust.

We illustrate this argument through the Labkar co-design workshop, in which we integrated AI imagery before, during, and after a co-design activity. The workshop itself is not the focus; rather, it serves as a concrete episode that reveals how involving AI-generated images reshaped the rhythm of our design process. Building on this case, we discuss broader implications for applied design research: the challenges, opportunities, and ethical tensions of treating AI as a design partner in civic prototyping.

AI imagery in design processes

Design has always relied on external representations—sketches, diagrams, storyboards, or models—as ways to think, communicate, and align perspectives. Donald Schön famously described design as a 'reflective conversation with materials,' in which drawings or prototypes respond to the designer and

shape the next move (Schön, 1983). Generative AI extends this conversation in new and unsettling ways. Prompts replace pencil strokes, and the computer returns not a rough sketch but a finished-looking image, often photorealistic, in a matter of seconds. This immediacy changes the tempo of design: what once took hours or days now takes moments, and the speed and fidelity of these images alter the social dynamics of design processes.

Research in human–computer interaction and design studies has begun to document these shifts. Generative images can act as powerful boundary objects: they create a shared reference point among people who might otherwise struggle to imagine the same thing (Star & Griesemer, 1989). For publics unaccustomed to drawing, AI-generated imagery can lower barriers to entry, allowing participants to react to and reframe what they see, rather than being excluded from conversations that privilege visual literacy (Sanders & Stappers, 2008; Manzini, 2015). At the same time, these very strengths expose new vulnerabilities. Design research has long shown how early examples can constrain creativity through fixation and anchoring (Purcell & Gero, 1996; Goldschmidt, 1991). When the first 'example' is a slick, photorealistic render, the risk of premature convergence is even higher.

Another issue is aesthetic and cultural homogenisation. Generative models, trained on vast online image repositories, tend to reproduce dominant visual tropes. Unless carefully steered, they produce 'default' urban backdrops and generic-looking users that flatten local specificity (Coulton, Lindley, & Akmal, 2022; Escobar, 2018). For civic prototyping, this is not a trivial flaw: an imagined prototype that looks like it belongs everywhere may in fact belong nowhere, erasing the social and cultural textures that matter most in public space.

Equally problematic is the plausibility of AI-generated visuals. A rendered image of a trailer set up on a Rotterdam square can appear indistinguishable from a documentary photograph of a real event. Stakeholders may assume such an image documents reality rather than speculates about it. While this can accelerate buy-in, it also risks misrepresentation, setting up expectations that the material prototype cannot yet meet. This blurring of fiction and fact raises questions of responsibility: when is an image an invitation to imagine, and when does it cross into deception?

Finally, we hold a position that AI should be understood not as a neutral tool but as a design material in its own right (Figoli, Rampino, & Mattioli, 2022; Lee, Law, & Hoffman, 2025; Shi et al., 2023; Stige et al., 2024)co-. Its biases, defaults, and affordances shape what comes out as much as a pencil or a CAD package does, albeit less transparently. Working with AI image generation thus requires not only technical skill in prompting, but also critical judgement about when to introduce images, at what level of fidelity, and for what purpose in the design process (Chiou et al., 2023). In our work on the Labkar, these questions became central. The challenge was not simply to use AI efficiently, but to choreograph its role carefully—keeping images open enough to stimulate creativity, situated enough to resonate with publics, and clearly marked as speculative rather than real.

Civic prototyping as frame

Civic prototyping and civic design providee a particularly demanding arena for experimenting with AI-generated images. Unlike product design or speculative studio work, civic prototyping is situated in the everyday life of streets, schools, and neighbourhoods (Björgvinsson, Ehn, & Hillgren, 2012; Le Dantec & DiSalvo, 2013). Prototypes here are not only technical artefacts but public gestures: they materialise intentions, invite people to participate, and test how ideas hold up when exposed to real social and spatial conditions. The emphasis is not just on what works mechanically, but on what resonates, what is trusted, and what can be sustained in civic contexts.

In this setting, representation has always been crucial. Images, diagrams, and mock-ups travel more easily than prototypes, circulating among funders, policymakers, and community partners who cannot be present at every iteration (Binder et al., 2015; Jaskiewicz, 2022). They allow ideas to be shared beyond the workshop table, to gather support and provoke discussion. Yet they also come with risks: the further an image travels from the act of making, the greater the danger that it detaches from the messy material reality of the prototype it represents.

What AI brings to this cycle is a new kind of acceleration and fluidity. The back-and-forth between building and reflecting, once constrained by the slowness of modelling or rendering, can now take place almost instantly. A physical prototype photographed on a phone can be re-imagined as a future

scenario within minutes; a speculative render can in turn shape what gets built in the next round. This creates the possibility of a more iterative and inclusive design process, where publics see their contributions visualised quickly and feel recognised in the unfolding design. At the same time, the same acceleration intensifies the risks: seductive images may outpace what can actually be built, eroding trust if not carefully framed.

For us, the notion of civic prototyping therefore demands more than the efficient production of images. It requires a careful choreography of how images and material artefacts move together—when they are introduced, how they are labelled, and how they are situated in public discourse. AI-generated visuals can strengthen this choreography if treated as scaffolds that accompany and support prototypes, rather than replace them. They should not be endpoints but instruments: temporary constructions that hold open the space for conversation while material prototypes do the slower, heavier work of testing reality.

The Labkar case

The Labkar project illustrates how these dynamics play out in practice. At Stadslab Rotterdam, the idea of a mobile FabLab-on-wheels had been circulating for years. We imagined a lightweight, bike-towed trailer equipped with modular Eurocrates and a rod system that could be reconfigured for different activities. The ambition was always civic: to lower thresholds, to reach beyond the walls of the FabLab, and to engage diverse publics in workshops and demonstrations in their own environments.

When dedicated funding arrived, this long-standing ambition suddenly became an urgent task. The Labkar was no longer just a vision—it had to be delivered as a working prototype. This urgency pushed us to explore AI imagery as a way of compressing the cycle between imagination, communication, and material testing. The question was not whether AI could generate attractive pictures, but how such images might scaffold an inclusive design process under time pressure.

We experimented with AI image generation (using OpenAI 4o image generator shortly after its release) in three ways. First, in the preparatory phase, we generated a series of Labkar visualisation variations—bike trailer, cargo bike, tuk-tuk, even van versions—progressing from sketch-like visuals to photorealistic scenarios (see figure 1). The resulting images (see figure 2.) were not treated as solutions but intended as a way to bring stakeholders and participants into the level of discussion we had earlier reached (Sanders & Stappers, 2008; Manzini, 2015). They made the abstract idea of a 'mobile lab' tangible and provided a common ground from which to explore possibilities.

Fig.1 Labkar visualisations have been generated through recursively adding generated images in OpenAI 4o image generator promts, requesting additional detail and modification, while increasing image fidelity.

Fig. 2. The resulting scanario-depitcing images were deliberatery generated to represent a wide variety of scenarios, while retaining key characteristics of the Labkar that we deemed important to its technical feasibility and provided as a constraint.

Second, during a co-design workshop held at the Smart&Social Fest, we used the above images to frame discussion and then shifted attention to more hands-on tools. Participants worked in small groups, building LEGO mock-ups of Labkar scenarios and annotating their models with intended uses and audiences. Ideas ranged from a cart fitted with sensors for citizen science to a pop-up cinema and a mobile kiosk rewarding community input with ice cream. Here, the AI-generated visuals functioned as scaffolds—helpful in setting the stage, but deliberately sidelined to avoid fixing the outcome too early.

Third, after the workshop, we translated the participants' LEGO mock-ups back into AI-generated images (see figure 3.). By using photographs of the models as inputs, we produced convincing visualisations that carried recognisable traces of the original prototypes. These images were not just prettier versions of rough ideas; they validated participants' contributions, allowing them to see their proposals 'made real.' They also created a portable portfolio of scenarios that could be shared with funders and partners, extending the reach of the workshop (Jaskiewicz, 2022; Jaskiewicz & Smit, 2024).

Fig. 3. Photographs of the LEGO contraptions (left) and photos of the participant annotations were used as input for Image Generator prompts used to generate high-fidelity representations of generated ideas (right).

The process did not stop there. We converged towards a generic Labkar prototype, built to test scale, dimensions, and operability in real urban settings. Photographs of this physical prototype were again fed into AI prompts, producing new visualisations of the Labkar in use on Rotterdam streets. This

back-and-forth—from speculative image to workshop, from LEGO mock-up to render, from physical prototype back to visualisation—became the rhythm of the project. Each cycle generated insights, raised new questions, and exposed both the opportunities and risks of partnering with AI in civic prototyping.

Reflections, through the NADR lens

Looking back at the Labkar process through the questions posed in the NADR call reveals both the potential and the fragility of AI as a design partner. What the project showed most clearly is that the real design work did not disappear with the arrival of generative imagery. Instead, it shifted—to framing, curating, and orchestrating how images are used in relation to publics, prototypes, and civic contexts.

One of the first challeng es we encountered was the issue of fixation. Decades of design research warn that early examples tend to narrow creativity, and our experience confirmed this in amplified form (Purcell & Gero, 1996; Goldschmidt, 1991). Photorealistic images, presented too early, risked being treated as finished solutions rather than starting points. Participants and stakeholders sometimes responded to them as if they depicted the Labkar that already existed, not simply possibilities under consideration. The danger was premature closure of the design space, and with it a loss of agency for those involved.

At the same time, we saw how AI could make participation more inclusive. For many people, drawing or sketching is intimidating, but responding to or modifying an image via a prompt is very accessible. By translating rough LEGO models into visually convincing scenarios, participants felt their contributions carried weight; their ideas travelled further, reaching audiences who would never have seen the workshop table. In this sense, AI operated as an amplifier, turning ephemeral gestures into legible propositions.

The question of creativity takes on a new shape in this context. When AI can generate endless variations, creativity is no longer about producing options but about deciding which dimensions matter, which images are worth sharing, and when fidelity should be high or low. Our task was less about producing visuals ourselves and more about structuring divergence, curating results, and translating them into commitments that could be tested in material form. Creativity, in other words, shifted from making to orchestrating.

This shift redefines the role of the designer. Rather than being the one who provides the definitive sketch, the designer becomes the choreographer of prompts, the mediator of plausibility, and the steward of responsibility. It was our task to decide when images should remain sketchy to keep the conversation open, and when they should be polished to mobilise action. It was our responsibility to signal clearly that renders were speculative, not documentary. And it was our role to hold the tension between images that inspire and prototypes that must eventually perform in public space.

These dynamics highlight both opportunities and threats. On the one hand, AI accelerated shared vision, broadened participation, and gave us low-cost ways of testing scenarios before committing resources. On the other, it risked homogenising aesthetics, producing shallow consensus, and displacing the slow, grounding work of physical prototyping. The challenge for applied design research is not simply to adopt AI but to develop practices that choreograph its use in ways that are inclusive, responsible, and situated.

Seen through the NADR lens, the Labkar case offers a clear message: AI in design is not about replacement but about redistribution. It redistributes where creativity happens, where responsibility lies, and where ethics must be negotiated. For civic prototyping, this redistribution matters profoundly, because what is at stake is not just the design of artefacts but the shaping of futures that communities are asked to inhabit.

Tensions, ethics, and conclusion

The Labkar process revealed that working with AI-generated imagery is less about efficiency than about managing tensions. At every stage we found ourselves balancing fidelity against openness, speed against depth, and plausibility against responsibility. A polished render could energise stakeholders but also risk foreclosing imagination. Rapid alignment could help us move quickly under funding deadlines, but it threatened to bypass slower conversations about governance and inclusion. Each seductive image of the Labkar in Rotterdam streets carried an implicit promise that the real prototype would soon follow; with that promise came obligations we could not ignore.

These tensions are not simply practical—they are ethical. Representing publics in AI imagery requires choices about who is visible and who is absent. Left unchecked, models produced generic, homogeneous users in generic, placeless backdrops. We deliberately prompted for diversity and local cues, but even then the risk of tokenism lingered. Similarly, translating participant mock-ups into glossy images gave their ideas new legitimacy, but it also raised questions of authorship: whose work is it when a communal sketch is filtered through a proprietary model and returned as a persuasive visual?

Civic prototyping makes these questions sharper. Unlike in a closed design studio, the outputs here travel in public space. Images circulate to funders, municipal partners, and community members. They can mobilise energy and support, but they can also mislead if not clearly marked as speculative. In this sense, AI images are not neutral design aids but civic actors: they participate in shaping expectations and responsibilities long before a prototype is wheeled onto the street.

What our experience with the Labkar suggests is that designers must approach AI imagery not as a shortcut but as a material that demands choreography. The task is to decide when to introduce images, how to frame them, and how to keep them tethered to the slower, more stubborn work of physical prototyping. If treated as scaffolds rather than outcomes, AI images can widen participation, accelerate iteration, and give communities a stronger voice in shaping futures. If treated carelessly, they can hollow out participation and undermine trust.

In the end, the question is not whether AI will become part of design—it already has. The question is how we as applied design researchers and civic practitioners position ourselves in relation to it. The Labkar case shows that our value lies not in drawing faster or rendering better than machines, but in holding the space between imagination and responsibility. We are choreographers of plausibility, stewards of inclusivity, and custodians of trust. Civic prototyping needs images that inspire, but more than that, it needs images that accompany, support, and remain accountable to the prototypes that eventually take to the street

Key takeaways

AI-image generation is reshaping co-design, not by replacing design work but by amplifying its tensions, where several open challenges emerge:

- Scaffolding or overshadowing? AI images can open up imagination and inclusivity, but risk sidelining the slower grounding of physical prototypes.
- Acceleration or premature closure? The speed and fidelity of AI outputs allow for rapid iteration, yet also intensify fixation and reduce space for open exploration.
- Inclusivity or tokenism? Generative imagery lowers thresholds for participation, but raises questions of authorship, representation, and whose voices are legitimised.
- Speculation or deception? The plausibility of AI visuals can mobilise publics and funders, but also risks eroding trust if not clearly framed.
- New roles for designers? Rather than image-makers, designers become choreographers of AI prompts and mediators of plausibility, but how to carry this responsibility in civic contexts remains unresolved.

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IkigAI: Co-reflection with Generative AI to Enhance Career Direction Clarity in Design Education

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Abstract

Design students and graduates often struggle to articulate and choose their career direction. Ikigai - a Japanese concept aligning what you love, what you are good at, what the world needs, and what can sustain you - can help. The authors discuss an experiment incorporating Ikigai into a Generative Artificial Intelligence (GenAI)-enriched workshop. GenAI may help students to align the four Ikigai sections into one sweet spot and suggest specific career directions. As a co-reflector, GenAI offers

custom feedback and is a partner for thinking. This IkigAI workshop has been delivered across multiple contexts since 2023, including higher educational institutions Inholland, TU Delft and Design Academy Eindhoven (DAE).

The most recent session for graduate students of DAE in September 2025 presents the empirical case study of this paper. We collected pre- and post- data via online questionnaires to assess whether one IkigAI session shifts career direction clarity (research question 1), and how AI- and human-led reflection respectively may contribute to that clarity (research question 2). Thematic analysis of pre- and post-data provided insights on the effectiveness of the workshop on participants' career direction clarity: GenAI can be a powerful tool for structuring thought and validating identity, but its impact is highly individual. Confidence shifts are modest and context-dependent, influenced by trust, clarity and relevance. Participants benefit from a hybrid model of GenAI and human facilitation, with flexibility for introspection. Career clarity often emerges as a blend of conceptual insights and practical action, shaped by developmental stage and personal values.

We discuss the larger potential of GenAI as co-reflector in higher design education, including risks and limitations. The contribution is a replicable, practical intervention for career direction clarity in higher design education. For design researchers, it offers first insights on human and GenAI contributions to career direction clarity. Design students and design practitioners benefit from an initial framework to receive custom career insights.

Introduction

Career direction

In our interaction with design students, **we noticed a frequent uncertainty** about career directions. For instance, a student reported that she was unsure about how to translate her interests in photography, culture and sustainability into concrete roles. **Unstructured connections** between personal interests, skills and employment opportunities may result in diffuse study and career directions. During studies, this unclarity may lead to doubts and difficulties to choose and find internships or assignment clients. After graduation, unclarity in early-career designers may lead to delay or barriers in taking concrete job applications steps.

Most design programs include self-, peer- or facilitated **career reflection practices** to offer structure and insight to students. However, their outcome **depends** on available human resources and may be providing **limited occupational options** depending on the educator's expertise and network.

GenAI

Generative Artificial Intelligence (GenAI) is increasingly used during the design process in higher education. Based on its rich knowledge, analytical processing and recent real-time internet access, we were **triggered to explore** how GenAI may contribute to career direction clarity and real-time occupational options. GenAI can generate examples, role models, and occupational information on-demand, provided that input prompts are specific.

Below we describe the process of developing, hosting and evaluating a workshop program that couples human-led sensemaking and accountability with GenAI-enriched career reflection.

Ikigai

Based on our positive experiences, we chose the **Ikigai construct as a foundational structure** of the workshop program. It is a Japanese noun meaning 'purpose in life' and used in education for personal development. The Western synthesis of the original work (Kamiya, 1966) has been popularized as a four-circle Venn diagram - aligning what you love, what you are good at, what the world needs, and what can sustain you. The central intersection represents the 'sweet spot'.

Embedding **Ikigai in higher education** fosters purposeful self-leadership and actionable reflection at scale, demonstrating that the concept can be operationalised (Hall et al., 2023). Kono and Walker (2020) add a process model that aligns with choosing among options and planning next steps. De Carvalho &

Raimundo (2025) show how an Ikigai lens connects purpose to concrete career intentions under real labour-market constraints in hospitality. These studies align with our research interest in exploring Ikigai for career direction clarity.

Co-reflector

Based on our interest to explore how GenAI may contribute to career direction clarity and real-time occupational options, we integrated GenAI as a **co-reflector** in the workshop. In this role, GenAI is providing an enriching perspective to the Ikigai sweet spot and career direction.

Rather than providing prescriptive output, the participant curates the GenAI output based on personal judgement and preferences During our workshop program, GenAI as co-reflector shall surface career direction clarity faster, supported by human facilitation and peer learning.

Career direction clarity

We define career direction clarity as student's confidence to take informed career decisions. We operationalize it with the **career decision-making self-efficacy scale**—short form by Betz & Taylor (1996). It culminates tasks relevant in career choices and well-validated in college samples (Buyukgoze-Kavas, 2013) and measures confidence with five core 'career choice competencies' (Mind Garden, n.d.):

- Self-Appraisal: confidence in identifying one's abilities, interests, and values to judge person-job fit
- Occupational Information: confidence in finding, interpreting, and using accurate, current career information
- Goal Selection: confidence in narrowing options and committing to a realistic occupational target
- Planning: confidence in mapping concrete steps, timelines, and resources to reach the chosen goal
- Problem Solving: confidence in handling barriers, setbacks, and decisions conflicts without derailing progress

We are aware that these confidence competencies **capture perceived capability** rather than concrete behaviours and commitment. We therefore included a commitment-focused question which will be elaborated in the table below.

Workshop program

The workshop was iteratively developed across multiple sessions between 2023 and 2025. The audiences varied from general to design-specific educational settings. The workshop was designed to fit a 60–120 minute slot, to produce tangible artefacts (GenAI outputs, filled worksheets), and to end with concrete next steps—aligning reflection with action during the plenary sharing. Table 1 below provides a complete, chronological overview.

The workshop follows design choices:

- A structured, timeboxed sequence of activities guided by the facilitator, involving plenary and individual exercises.
- Blending analogue brainstorming with pen and paper with by three rounds of GenAI integration for co-reflection.
- Guiding presentation materials including pre-written GenAI prompts to reduce cold-start issues and include novice GenAI users.
- Easy-to-fill visual worksheets printed on A4 paper which participants fold into a small magazine for focused handwritten brainstorming.
- A co-reflection process starting with human reflection (answering four Ikigai questions) and synthesis (defining the sweet spot) to promote reflection and ownership. Afterwards, GenAI is integrated via three prompting rounds (structured prompt; role-play creative prompt; detailed context-specific prompt) to enrich human insights.

Figure 1: IkigAI workshop at CIMIX Conference Vienna in January 2025

Earlier sessions did not include structured data collection. Yet, they iteratively improved facilitation and analogue/digital flows. The most recent workshop delivered in September 2025 introduces a systematic pre/post data collection.

Table 1. Overview of IkigAI workshops in chronological order

#	Venue/ context	Date & Duration	Audience	Data	Notes
1	DigiQuest event, Amsterdam	11-2023, ca. 45 minutes	4 interdisciplinary students	Informal facilitator observations	Initial prototype of the workshop
2	Talent for Good fair, The Hagu	06-2024, ca. 60 minutes	23 young professionals		In collaboration with the organizer / host
3	Urban Leisure & Tourism Lab, Amsterdam	09-2024, ca. 90 minutes	21 interdisciplinary students		In coordination with lab leader
4	TU Delft Synergy Week, Delft	10-2024, ca. 120 minutes	38 interdisciplinary students	Informal facilitator observations, short online feedback form	In collaboration with organizer / host
5	DigiQuest event, Amsterdam	11-2024, ca. 60 minutes	55 international students and pupils	Informal facilitator observations, photos, videos	Focused on DigiQuest teams
6	CIMIX creative industry conference, Vienna, Austria	01-2025, ca. 90 minutes	82 international design practitioners		Custom branded workshops for participants
7	Graduates of Design Academy Eindhoven	09-2025, ca. 120 minutes	13 students	Informal facilitator observations, **pre- and post questionnaire**	In coordination with academy leader

Method

Study design

Given the iterative nature of the workshop sessions and its emergence from practice, research was embedded at a later stage. **The latest session in September 2025 collected traceable empirical data for this paper**. We therefore adopt a qualitative-dominant, single-group pre/post field design to share explorative insights.

Figure 2: IkigAI workshop at Design Academy Eindhoven in September 2025

Research questions and questionnaires

To conclude the effectiveness of the workshop on design students' and graduates' career direction clarity, the following research questions were defined:

Primary (RQ1):

How does the IkigAI workshop change participants' career direction clarity from pre- to post-session?

The primary research question covers the effectiveness of the workshop on career direction clarity of participants. The sub-questions are based on the short form of the Career Decision-Making Self-Efficacy Scale by Betz & Taylor (1996), presented in a grouped Likert scale in the questionnaire. Table 2 provides an overview of the questions, please refer to PreQ6 and PostQ6 for details.

Answering this research question is relevant to design practitioners as it informs them if an IkigAI session is effective for career direction clarity. Design researchers are provided exploratory insights on career clarity direction constructs, collected with a low-friction workshop – useful for replication in higher design education. For design students, this research question answers their practical question if this workshop helps them get unstuck in their career direction.

Secondary (RQ2):

How do GenAI- and human reflection contribute to perceived clarity?

This research question investigates an initial cause-effect-relationship .

It is relevant to design practitioners as it explores why to lean on GenAI as co-reflector. That translates directly into a repeatable framework in practice. For design researchers, this research question explores the potential of co-reflection with GenAI. Design students experience how to use GenAI

responsibly in reflection and figuring out when it helps, and when to pause for self-, peer-, or facilitator feedback. The structured process helps them turn output into decisions and strengthening reflective judgement.

Table 2. Overview of pre- and post- questions

PRE questionnaire	POST questionnaire	Remark
PreQ1: consent for anonymised use of responses for research/ publication		Answer 'no' finishes form
PreQ2: Anonymous code	**PostQ1**: same as PreQ2	For matching
PreQ3: Role (multiple choice)		For research population description
PreQ4: Goal for workshop (multiple choice) **PreQ7**: Career challenge (multiple choice)	**PostQ2**: Outcome: What about your career direction became clearer? (open) **PostQ3**: Next step: one concrete action you will take (open)	For RQ1
PreQ5: Confidence career direction (0-10 scale)	**PostQ4**: Confidence career direction (0-10 scale)	For RQ1
PreQ6: Confident to (1-5 scale) PreQ6 A: identify realistic career direction that fits strengths and values PreQ6 B: choose between plausible directions PreQ6 C: set two concrete next steps toward chosen direction PreQ6 D: find and use information to evaluate direction PreQ6 E: adjust plan and keep moving if you hit obstacles	**PostQ6**: same as PreQ6	For RQ1
	PostQ5: Main source of clarity (multiple choice) **PostQ7**: Human moment: concrete moment where you / the facilitator / peers shifted your thinking. (open) **PostQ8**: GenAI moment: Give one concrete moment where a GenAI output shifted your thinking. (open)	For RQ2

Data sources

We used Microsoft Forms to collect data and Microsoft Excel to analyse it. The questionnaires contained 7 pre- and 8 post- questions in multiple-choice, scale and open-ended format. The five-item career direction clarity confidence was collected in a Likert scale with 5 gradients, as well as a general confidence slider from 0-10.

The facilitator observation log captures notes and notable pivots that contribute to the discussion section below. The authors applied GenAI tools (Microsoft Copilot and ChatGPT) to refine questionnaire questions, streamline wording and assist in thematic analysis.

Ethics and data protection

Participation was voluntary with explicit consent. Consent was asked in the pre- questionnaire. Anonymous codes were randomly shared among participants to enabled comparisons per person without personal identifiers. Photos and worksheets were only retained or published if consented. Data retention and storage followed institutional policy.

Data analysis

Table 2 provides a detailed overview of questions and how they were compared for Research Questions (RQ) 1 and 2. We conducted reflexive thematic analysis (Braun & Clarke, 2006) of pre- and post-data in Excel. We identified, analysed and reported pattered meaning (themes) across the dataset. We first exported the saved data from Microsoft Forms to Microsoft Excel, then familiarized with the data to generate codes and search for themes and consequently produced below report with analytic narrative and original quotes.

Quantitative deltas in the confidence career direction scales (PreQ5,6 and PostQ4,6) were used to contextualise themes of open-ended or multiple-choice questions, and to select contrasting exemplars.

Results

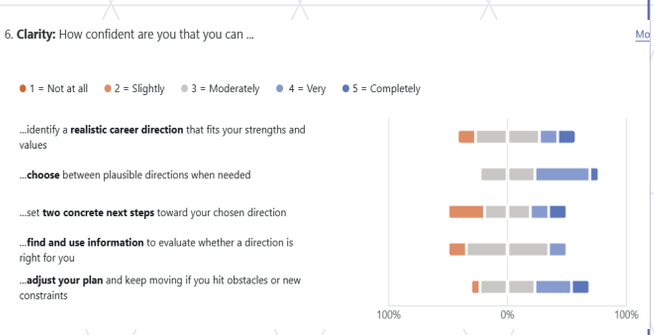
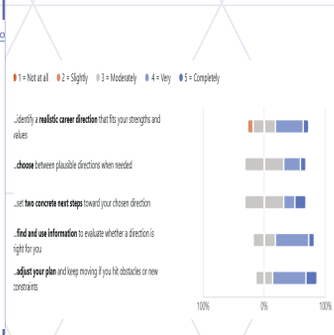
Synthesis

We processed 13 consented pre- and 11 post workshop online questionnaires from the session at DAE on 25th September 2025. Based on the anonymous code, we matched eight pre- and post questionnaire datasets. The majority of the respondents were recent graduates and undergraduate students, and a small portion of early- and mid-career practitioners.

To analyze the answers contributing to **Primary (RQ1):** How does the IkigAI workshop change participants' career direction clarity from pre- to post-session?, we found the following themes:

The average **career direction confidence level**, measured on a Likert scale from 1-10, **increased slightly: from 5,5 before, and 6,4 after the workshop**. It mainly helped participants to find and use information to evaluate whether a direction is right for them, adjust their plan and keep moving, as well as setting two concrete next steps. Table 3 below provides a detailed pre vs. post overview.

Table 3. Comparison of answers on career direction clarity confidence

PRE questionnaire	POST questionnaire
	

The main goals of respondents was a clearer direction, better understanding of strengths, and a concrete next step. They defined their career challenges as lack of confidence, time and energy constraints, too few career options and fear of a wrong choice.

Respondents gained **clarity on aligning their passions, strengths, and values with potential career paths**—ranging from specific roles (e.g., designer in mental health) to broader realizations about working in systems, pursuing unconventional careers, and taking confident steps forward. Some

also identified job titles, potential directions, or acknowledged personal growth, while one respondent reported no new clarity. *'When ChatGTP told me I am a mediator, I really resonated with that*.' - This quote reflects how GenAI can affirm personal identity, which in turn strengthens career clarity and confidence.

In the next two weeks, respondents planned to take concrete steps such as refining their career direction, applying for jobs or residencies, updating professional materials, reaching out to potential collaborators, and using AI for planning and self-reflection. Some also aim to build confidence and deepen their understanding of their goals.

A potential pattern emerged around the **role of identity affirmation and conceptual clarity** in boosting confidence. Participants who **resonated with GenAI outputs** that reflected their values or strengths tended to report higher clarity and confidence. Conversely, those who found **the AI vague or biased** experienced diminished trust and clarity.

To analyze the answers contributing to **Secondary (RQ2):** How do GenAI- and human reflection contribute to perceived clarity?, we found the following themes:

The additional clarity gained from the workshop was **mostly balanced between integrating human and GenAI interaction**. AI-driven clarity was gained for those who engaged deeply with GenAI and self-driven clarity for introspective respondents.

Respondents experienced shifts in thinking **through personal reflection, peer input, and AI interaction**—such as using AI to explore values like Ikigai, learning prompt techniques, and recognizing the importance of specificity. Some found clarity through writing or reading (e.g., '*Trying to understand what I want to bring to the world*'), with fewer mentions of peer or facilitator influence.

This may reflect the **individualized nature of career reflection**, even in group settings., while one respondent questioned the workshop's objectivity and relevance.

Human moments were often **internal** (e.g., '*Writing it down for myself*', '*Trying to understand what I want to bring to the world*'), with fewer mentions of peer or facilitator influence. This may reflect the **individualized nature of career reflection**, even in group settings.

Respondents described moments where GenAI outputs helped clarify their thinking—such as **structuring vague input, reflecting through idol-inspired responses, and recognizing AI's limitations**. Some gained insight from creative prompts, like assigning AI a persona or receiving unexpected feedback. Others noted shifts when AI challenged their assumptions or asked deeper questions, while a few expressed scepticism or had neutral experiences. The quote '*When I realised I did not hear any negative points/warnings about AI, I lost my trust at all*' highlights the importance of perceived neutrality and transparency in AI-supported workshops, and how lack of critical framing can erode trust.

Limitations

Due to the limited dataset available, our results have a low validity and generalisation is restricted to the session configuration used.

As GenAI tools undergo regular updates with increased capabilities and knowledge, GenAI outputs can vary across providers and versions (model drift). For transparency and reliability, we advise further research to keep a GenAI technical log including details about provider, model name and version/date, parameters) to support traceability and interpretation.

Overall constraints include wifi connectivity for GenAI tools, legibility or photo uploading errors or novice GenAI users. Overall enablers that we discovered are an inviting room setup with space to write with pen and paper, and use a laptop or mobile phone, prompt templates on the screen, and intro/outro by the event host.

Discussion

This exploratory analysis reveals a small improvement in career direction clarity confidence among participants (from 5,5 to 6,4). The workshop helped many align passions, strengths and values with potential career paths. The increase in confidence was often tied to identity affirmation and the ability to articulate the next steps.

However, not all participants experienced increased clarity. One respondent reported no change, and another experienced a decrease in confidence, highlighting the importance of trust, tone and perceived neutrality in GenAI-supported workshops. The quote '*I lost my trust at all*' underscores the need for critical framing and transparency in AI-supported workshops.

GenAI's impact is highly dependent on prompting strategy, tone, and perceived relevance. It was effective for structuring vague input, offering unexpected insights, and affirming identity. Human reflection – often internal and introspective – was equally important.

GenAI outputs are subject to model drift, making reproducibility a challenge.

The small sample size and single-session format **limit generalizability**. We encourage further researchers to maintain a technical log (provider, model version, prompt history) to support transparency and traceability in future studies.

Key takeaways

This explorative study offers initial insights into how an IkigAI workshop may influence career direction clarity and the role of GenAI and human reflection in that process. The findings are particularly relevant to design practitioners seeking effective career development formats, design researchers exploring reflective tools in design education, and design students navigating early career decisions.

- **Career clarity slightly improved through the IkigAI workshop**
- The average career direction confidence increased from 5,5 to 6,4 on a 10-point Likert scale. While this shift is modest, qualitative data suggests that participants gained meaningful clarity through aligning personal values, strengths, and passions with potential career paths. This supports the workshops' utility as an approachable intervention for design students and recent graduates seeking direction.
- **Identity affirmation through GenAI can strengthen clarity**
- Participants who resonated with GenAI-generated roles reported increased confidence and clearer narratives. This suggests that GenAI can serve as a mirror for identity exploration, which is particularly valuable for design students and practitioners in transitional phases. However, this effect is contingent on perceived relevance and tone of the GenAI output.
- **Career development is an iterative process**
- While the workshop yielded positive shifts in perceived clarity, there is a risk that short-format interventions may foster superficial clarity rather than deep, reflective, sustainable career insights. The tendency to accept GenAI-output without self-examination and didactical guidance could lead to premature decisions or overconfidence For design educators and researchers, this raises the question on how to ensure that reflection is embedded within longer-term processes at the educational institution.
- **Trust and neutrality in GenAI outputs are critical**
- One participant's loss of trust due to perceived bias ('no negative points/warnings about AI') highlights the importance of transparency and critical framing of GenAI-supported workshops. For design researchers and practitioners, this underscores the need to design GenAI interactions that are balanced, reflective, and critical.
- **Human reflection remains central**
- Participants often cited internal reflection (e.g., writing, conceptual thinking) as key to gaining clarity. Peer and facilitator input were less frequently mentioned, suggesting that career reflection – even in group setting – is deeply personal. For design educators and researchers, this points to the importance of scaffolding individual reflection within collective formats.
- **GenAI is most effective for structuring and clarifying**
- Participants used GenAI to transform vague inputs into structured ideas, explore values, and generate next steps. This pragmatic use of GenAI aligns with design student's needs for clarity and actionability. However, effectiveness depends on prompt quality, user familiarity, and technical reliability – factors that should be considered by facilitators.

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Learning from Artists and Their Computers

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Abstract

Quite literally, our title marks the perspective we worked out for this article. What is the value of creativity if anyone can generate 1000 ideas at the touch of a button? And how do artists and designers that create at the forefront of digital art and design maintain and develop this value? How do they engage with computation levering it for societal sensing, individuation and joy? In a conversation between two researchers of the arts and applied design with three diverse and internationally renowned artists, we unpack how the design of processes, workflows and automation is part of the creative process. Together, we explore what attitude and skills are important to stay creative in times of industrial digital supply chains and tools, e.g. those based on Large Language Models. With increasing evidence of the negative impact of off-loading cognitive tasks to digital assistants for creative and knowledge work, the article synthesises inspiring digital creativity counter-tactics, supporting practitioners and students alike in keeping their creative muscle strong.

Introduction

In the 1976 promotional documentary 'The Artist and the Computer' (Ball, 1976), produced by American telecommunication company AT&T, early computer artist Lillian Schwartz describes a collaborative and complementary relationship between the artist, the machine, and the engineer. She positions her role as someone who can bring emotion and intuition to make sense of various computational output as if it was a raw material that still requires specific human editorial skills to become an expressive artistic medium. This perspective may surprise today, when the vast majority of computational tools at the disposal of creatives have turned this collaborative and complementary relationship into economic models in which all the attention is on the output and its economic usefulness (Berends & Snelting, 2025). This situation is particularly exasperating in the current GenAI bubble, in which Technology CEOs will go as far as claiming that creatives do not like spending time on improving their practice and do not find it enjoyable to put work into making things and acquiring new skills (Stebbings, 2025). Artists however, particularly the ones working the field of computer generated art and synthetic media, have started to become more vocal about such provocations. In fact, for them what matters is rarely the output, it is

the creative process, the workflows, and the identity formation that happens when working in specific individual and collective artistic situations, within the field, and during their education (Hiscott & Rusher 2025). Reducing creativity to problems of automation and production that can be optimised by computation routinises cultural production. There is however an existential risk in reducing every single human activity to a routine when the uniqueness of our species lies in everything we do that is not routine (Polychroniou & Chomsky, 202 3).

As an attempt to encourage the collective problematisation (Stengers, 2019) of computation in arts and design — and half a century after the AT&T documentary that accidentally offered a glimpse of the delicate balance between on the one hand the computer as a creative instrument, and on the other hand, the colonisation of creative practices for the services of what would be become the ICT industry — we interviewed three artists working closely with computers. With this interview we hope to highlight the importance and messiness of the creative process, its diversity, and complexity, and learn from it.

The Artists

Introduction to the artists and their practices

Anja Overdiek, Aymeric Mansoux (AOAM): Can you present yourself and your work. We are particularly interested to learn more about the role of computation in your practice. Do you make a distinction between computation as a creative medium and computation as a tool to assist creativity? Do you also work with other materials and tools. Do you engage differently with them than with computation?

Sarah Groff Hennigh-Palermo (SGHP): Artistically, I am most in sympathy with the colour field painters, minimalists, and experimental video artists. That is, I care about aesthetic productions as inquiries into the nature of materials. And so, for me, computation is a material investigation. It manifests itself differently: sometimes as an accessible means to re-create an effect; sometimes as the result of a production, as with toolmaking; and often as the focus of the query. Recently, I presented a paper discussing the material differences and implied conceptual differences between creating time-based art with film, video, and digital graphics, namely the level to which each expresses the quality of continuity.

Nan Wang (NW): I am a media artist and experimental filmmaker working with both digital and analogue technologies. My practice revolves around reinventing marginalised and de-commodified technologies from the past - particularly analogue moving image formats and pre-cinema devices. I'm drawn to the kind of visual 'noise' that emerges from material processes: imperfect, unstable, and revealing hidden textures, systems, and identities. Since 2012, I've moved away from relying on standardised digital tools. I now integrate electronics and analogue film, which has deepened my understanding of both image-making and computational systems. For me, computation is not just a utility but a material – unstable and often unpredictable. I build many of my own tools, seeking creative potential in glitches, mistakes, and non-standard operations.

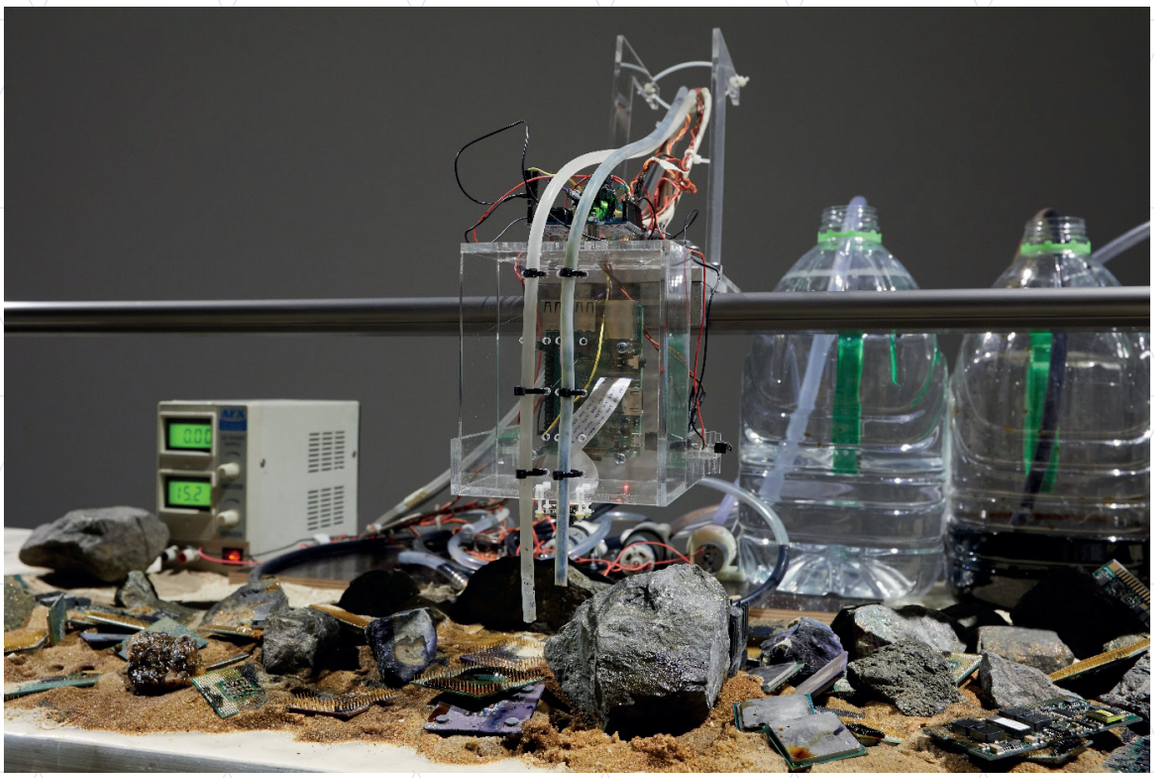

Image 1. Execution Host Shanghai by Martin Howse.

Martin Howse (MH): Computation is the awful and unknown dusty matter and spirit of my work; there is no distinction between the medium of computation and its use as tool. I am muddily immersed in computation as a refined post-geological, circulating and controlling substrate, I am subjected to the computational and thus to the despised earth. I investigate the process of the subjection of the earth to technology as a foundational layer. I see the earth as a geological necessity which processes the human imagination. My exploration focusses on the crystalline and corrosive sublimate interior composed of contained (endophysical or algorithmic) and material self-reflexive loops invoking the first two processes. This practice places intrinsic voids in code and logic, which could perhaps be witnessed as failures of utility or non-symbolic.

SGHP: Mostly, I make live, improvised video works in performance together with a musician. I also create lightly edited single-channel improvisations which can have sound or be silent. For these I use some combination of code; vintage, emulated and contemporary modular video synths (analogue video processing devices); and digital video effects. I also create the tools I use to live-code a lot of the Memphis-y base graphics, notably La Habra, a ClojureScript (programming language) framework for visuals, and Olio, an SVG sequencer (vector graphics animation tool). I usually do some versions of live coding (performing art involving live programming) images and then passing them through a number of effects. More recently, I have been playing with static and feedback as primary elements.

NW: During my master's studies at the Piet Zwart Institute in the Netherlands, I began exploring dust as both a material and conceptual element. Dust contains bodily traces and environmental residues —shed skin cells, hair, particles of daily life—forming a kind of abstract self-portrait. In 'Dust Poetry' (2013), I used dust from my room to create short films. I scanned it digitally and exposed it directly onto 16mm film, merging analogue and digital processes. In 'The Dust Room' (2015), I used modified slide projectors to cast moving images of swirling dust. The installation fostered a micro-physical exchange: visitors inhaled particles of me, despite my absence. It was an intimate and unsettling encounter with presence, materiality, and disappearance. Over time, I began building my own DIY projectors and integrating new technologies. This led to works like 'The Liquid Self' (2022) and performances including Liquid Pulse (2017) and 'Hue Shifts'(2023). These projects reflect a shift toward hybrid practices that engage both computation and materiality.

MH: Projects such as Dissolutions (2016) question the necessities and affordances of the earth as a material substrate for technological and computational infrastructures. They research circulations implicit in algorithms and in the global extraction of rare earth minerals, reconfiguring unstable procedures and materials extracted from both obsolete hardware and from rare earth mining sites. Other materials and processes I engage with which are used to expand computation, and to inform coding

practice and hardware development include: fermentation, alchemical dissolution, dusty divinations, worm composting, puppetry, rotting, emulation, observation, invocation, shifting execution, and ghost-making.

Computation and worldview

AOAM: How does using computation in your work inform or shape aspects of your worldview? For instance: sustainability, authorship, automation, labour, inclusivity, autonomy, originality, aesthetics and tech-optimism. In your opinion: how much of this shaping happens consciously or intuitively?

MH: My artistic immersion informs an ascetic worldview according to dream-like spiritual and algorithmic cycles. 'Tiny Mining' is an example of a project which promotes an ascetic, technological worldview. It proposes the ongoing extraction of rare earth metals from within the human body as a daily practice which informs personal lived ideas of human autonomy and automation, digital labour and originality. We are coded by the earth, to eat and excrete technological artefacts. Computation as a ghost execution vehicle implies a closeness to the realm of the dead (defined negatively in sole opposition to the living, and no longer defined by or for the living). This is why an early, ongoing project, Island2 (2010) aims to establish a hole or void in the physical memory of every single server, desktop, laptop and smart phone on the planet to stand in for and to hold the dead.

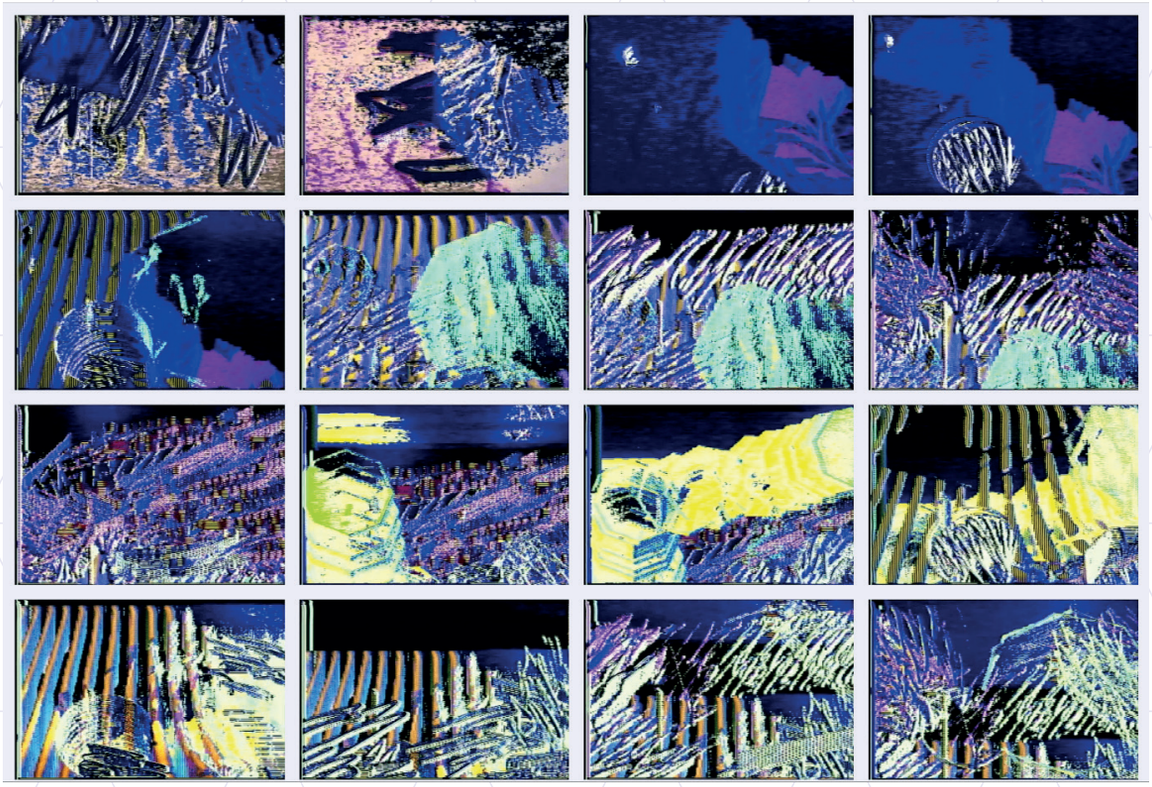

Image 2. Frames from a single-channel video work made with code and vintage synth by Sarah Groff Hennigh-Palermo.

SGHP: Seeing computation as a material and not a method can stand as a rebuke to the current popular methods of framing computing as the ultimate structuring metaphor for existence (our brains are just neural nets!) or inevitable technical disruptor. Such claims are invariably accompanied by the assertion that computers are neutral. I am saying that not only are they not determinative, not inevitable; they are not neutral either! Computing as a material is something you can interrogate. All my other observations about computers as tools of violent classification, fonts of environmental disasters, and the like — and the outrage I feel about it — comes from exploring them materially and culturally.

NW: My relationship with computation is tied to authorship, autonomy, labour, and access. Standardised software dictates how and what we can create. So I ask: Who controls the tools? Who decides what creativity looks like? My Professional Doctorate research explores alternative approaches to audiovisual technologies by reimagining and rebuilding analogue film devices — contact printers, optical sound readers, cameras — using contemporary fabrication techniques. Through collaborations with artist-run film labs and archival research, I investigate the histories and mechanics of these 'de-commodified' machines and adapt them for current use. This isn't nostalgia — it's resistance. It's

about creating space for alternative aesthetics, slower methods, and embodied engagement with technology. I believe in offering artists the option to work differently — beyond high-tech, commercial infrastructures. But I'm also aware that analogue practices require space, time, and access to rare tools — resources not available to everyone. That's why I aim to redesign devices that are simpler, more affordable, and open — so artists with limited resources can still access these practices.

SGHP: By approaching computing as material from different angles, and pushing it till it breaks or does something really interesting or easy or difficult or boring in its role as light-displayer or specifier of light displays, I am able to engage it non-lexically and non-symbolically. I think this means that the understandings I derive are critical but not just on the social level. This practice, and using machines from a variety of eras opens up the space to imagine computing differently.

Technology skills and/or critical perspectives

A**uthors:** How have you acquired both the creative and technological skills and critical perspectives in your work? We see a tendency in digital art to prioritise critical reflections from the perspective of being a user of ready-made ICT tools, such as GenAI, over more in-depth technical engagement with computation. How do you experience this?

NW: I come from an art and design background, with technical skills developed through workshops, self-learning, and peer collaboration. I often build what I need, simply because it doesn't exist. I've observed a growing reliance in digital art on proprietary AI tools that are often opaque and embedded in commercial systems. Without critical engagement, creatives risk becoming passive users, constrained by software updates, default settings, and hardware compatibility. I'm not opposed to AI in creative practice, but I advocate for informed use and artistic agency. In my work Echoes Between Seeing (2025), I run an older version of Stable Diffusion (Generative AI) locally. I feed it abstract 16mm film footage using image-to-image processes to generate dreamlike reconstructions that retain the visual logic of my analogue work. This process requires familiarity with coding, diffusion models, and virtual environments. But it's not about technical fluency — it's about artistic control. I use AI not for efficiency, but to test its limits and aesthetic possibilities. Running open-source models locally, rather than relying on cloud-based services, gives artists greater control over output and consistency.

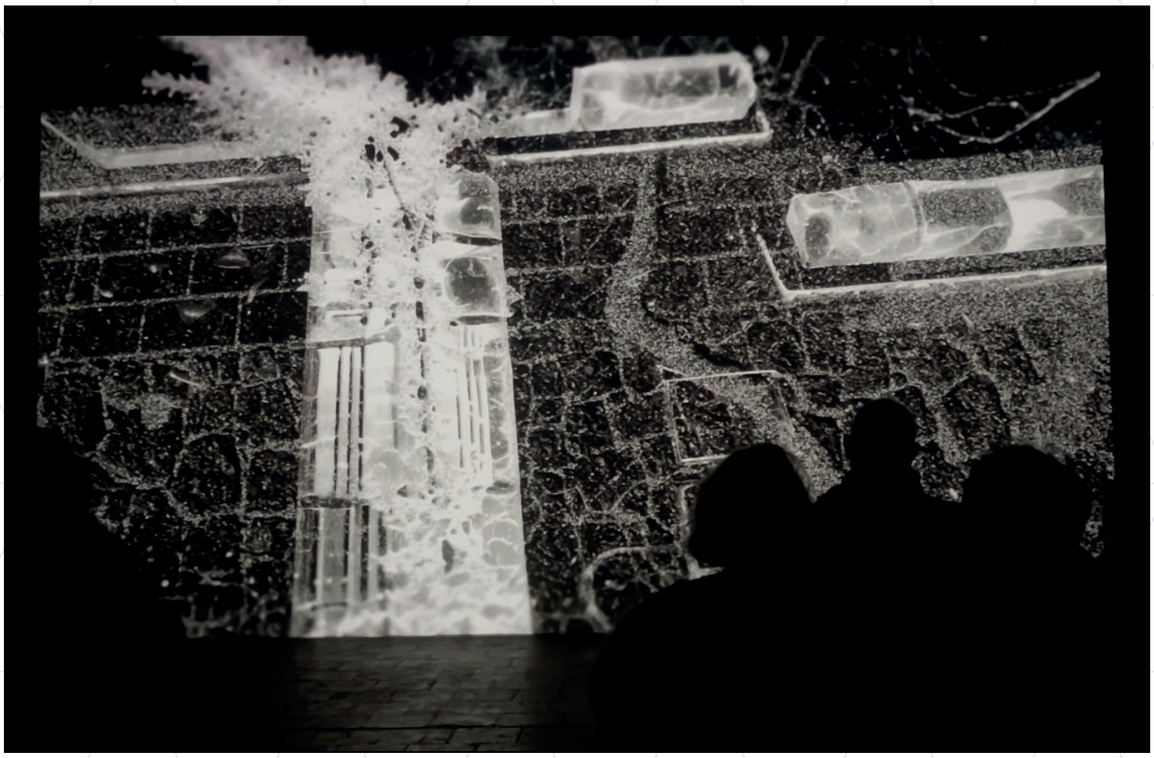

Image 3. Echoes Between Seeing by Nan Wang.

MH: My creative and technological skills are acquired through working and unimaginable dreaming about obsolete, debased and broken magical technologies. I develop critical perspectives through the misguided application of fiction and contemporary philosophies to coding and the materials of

technology. I clumsily re-code and appropriate ready-made ICT tools and language. In order to subject these, as things, to fire and dissolution, they would by necessity be moulded of matter, admitting the crackling, voiceless 'noise of angels'. This is difficult to accomplish in code, or with present tools. Computation is brittle. It crashes or breaks easily under material stress. To subject open source AI models and code stacks to cycles of dissolution and decay remains a machine dream.

SGHP: My perspective and my technical skills grew alongside one another. As I better understood computing, I saw opportunities for divergence. I started learning to code independently at the beginning of the data-visualisation boom, and as I worked with data, the creepy side became clearer, so I removed the information but kept the pictures. At one residency, I learned about parsers (software that builds a data structure from text) and discovered computers weren't magic at all! They were made by idiots just like me. In grad school I got skills and the full propaganda. After grad school I got into live coding, was introduced to analogue video synths and saw something else: the way we can democratise understanding and build real, vital imaginative communities through an approach that somehow unifies computation as material and an experimental spirit. For me, Artificial Intelligence is the opposite of all of this and inherently anti-art.

Computers: keep them or burn them?

SGHP: Computers? Keep them … in their place. As tool rather than metaphor. But the internet? Bring back using it two hours a day, and only from your living room or the internet café.

MH: Given that the absolute logic of control and containment exercised by computation results in an earthly rebellion of heat and thermal noise, I would suggest a self-propelling conflagration induced by excessive processor heat and generated during the extended calculation of lunar and solar alignments for the site of the server farm in question. This could be followed by divination, night visions and dream incubation by way of the inhaled, ingested and serpentine fumes from the smoking electronics.

MH: As we cannot eliminate software all at once, we should leave nothing undone that might contribute to its falling into disrepute. To bore one hole after another in it, until what lurks behind it - be it something or nothing - begins to seep through.

NW: For me, computation should not be reduced to a tool of polish or productivity. It can be a space for failure, poetic misuse, slowness, and resistance. That's where its true creative potential lies. So: computers — do we keep them or burn them? Maybe we keep the computers, but we burn the default settings. As artists and designers, we need to intervene, break open the tools we use, and imagine new possibilities. It's not just about what technology can do for us — it's about what we can do to technology.

Key takeaways

We as academics thank the artists for sharing the richness and variety of their creative practice with computers. As researchers and teachers of future artists and designers, we would like to conclude with three insights we had with this conversation.

- Computation and digital tools should be treated as material to experiment with, to investigate and question. They should be applied for individual and collective, work practice and human/ecological goals, as opposed to being extractive and prefabricated tools for predetermined goals, often overlapping with exploitation and control.
- Curiosity about and intricate knowledge and skills in digital technologies, esoteric programming languages, and bespoke (free, libre and open-source) hardware and software stays important in times of industrial digital supply chains and computation intensive tools, e.g. those based on Large Language Models.
- Human creativity feeds on the ability to relate to processes of the unconscious mind and to divers sources of inspiration, including the past. Space for failure, poetic misuse, slowness, and resistance to popular narratives of progress supports this ability.

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The Misunderstanding of Creativity: Why AI and Human Creativity are Not Equal

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Abstract

AI impacts how we learn, develop, and use creativity (Marrone, 2023). It is, however, debatable whether AI can be creative; AI's yield, rather, corresponds to products that are attributed 2010). Finally, there is the question of whether creativity is rational at all (Gaut, 2010) and so could it even be 'programmed'. Looking at the use of creativity in problem-solving, I will argue that human creativity involves a 'knowing that comes through me, but is not of me' (Pomeroy and Scharmer, 2024) and so human creativity is a process that AI could never replicate.

Introduction

Recently, artificial intelligence (AI) has become increasingly influential in education, innovation, and the arts, reshaping how we learn, express, and create (Marrone, 2023). As AI can be given instructions to generate art, compose music, and write texts, a central question emerges: **Can AI truly be creative?** It is part of the debate whether AI-generated outputs qualify as 'creative' in a way that is meaningful. Runco (2023) argues that such outputs are better described as *attributed creativity*: they appear creative but lack the underlying processes that define human creativity. Erden (2010) also states that applying the label 'creative' to AI is a category mistake, based on a narrow, mechanistic view of creativity. If, as Gaut (2010) suggests, creativity is non-rational or intuitive in nature, it becomes doubtful that such a creative process could be programmed or simulated with AI.

It is here that we must consider how we define creativity in relation to being human. Therefore, we must consider not only the **cognitive, structured process,** but also the **social and experiential dimensions** of creativity. Creativity and art do not occur in isolation; they emerge through, and their meaning is negotiated through, shared (cultural) experience, dialogue, and collective meaning-making (o.a. Verneert et al, 2021, Dewey, 1934, Lehikoinen, 2025, Sannino, 2014, Glăveanu 2010) by people. In *Artistic Citizenship: Artistry, Social Responsibility, and Ethical Praxis*, Elliott, Silverman, and Bowman (2016) argue that artistic practice is deeply embedded in community life and social responsibility. Likewise, Dewey's *Art as Experience* (1934) emphasizes that art and by extension, creativity is fundamentally **relational**, arising from lived experience and communal engagement. Social arts practices, such as those documented in *Social Arts: The Power of Participation* (Clift, 2020), further highlight how creativity is co-constructed through participation, empathy, and shared purpose.

These insights challenge the notion that creativity is merely about innovative combinations or output. Rather, creativity is an **embodied, emergent, and relational** process grounded in human experience, culture, and intersubjectivity. As Pomeroy and Scharmer (2024) suggest, creativity often involves 'a knowing that comes through me, but is not of me,' pointing to a process that also transcends individual cognition and thus cannot be programmed.

This essay argues that AI cannot be truly creative, because human creativity is a deeply social, embodied, and ethically situated phenomenon that AI cannot replicate. By exploring the role of creativity in problem-solving, community art, and socially engaged practices, I will show that the essence of creativity lies not in the novelty of output, but in the shared human processes from which it, and its meaning emerge.

Theories on creativity

Creativity does not have a fixed or universal meaning; rather, its meaning is negotiated through ongoing social interactions, cultural norms, and personal values that both enable and constrain what counts as creative. Keating (2009) argues that individuals participating in discursive practices do more than reproduce existing norms they negotiate the experience of self ('the person in the doing'), shaping what is seen as meaningful in creative work through their engagement with power, history, and language in communities of practice. Societal norms, what a culture generally expects, rewards or forbids, play a big role in defining creativity. For example, in *Creativity and Leadership in the Creative Industry: A Study from the Perspective of Social Norms*, societal descriptive norms (what others are observed to do) and injunctive norms (what others believe ought to be done) are both shown to have strong positive effects on individual creative expression, indicating that people internalize shared expectations about creativity and conform (to some degree) to those expectations. Personal values likewise shape what one believes to be valuable, novel, or appropriate: studies of innovation behavior show that traits such as *openness to change*, *selfdirection*, and autonomy, as components of personal value systems, are strongly correlated with innovation and creative action in work settings. Thus, creativity emerges in the tension between societal norms (what the community accepts or rewards) and individual values (what one is motivated to pursue), mediated by interaction, feedback, and negotiation among people

Creativity is a multifaceted concept that has been defined and theorized across disciplines. Runco and Jaeger (2012) define creativity as the production of ideas that are both novel and fitting within a given context. This aligns with the 'novel and appropriate' framework, which posits that for an idea to be considered creative, it must be both original and useful. In contrast, Brandt (2021) argues that in fields with low consensus, such as the arts, value judgments are subjective, and external judgments can be a poor barometer for determining creativity. This perspective highlights the importance of personal production and public reception in defining creativity. Additionally, Greeno et al. (2023) propose a process-oriented definition of creativity, emphasizing that creativity involves a sequence of activities, including problem construction, information search, idea generation, and idea development, which unfold over time. This view underscores the temporal dimensions of the creative process and the dynamic nature of creativity. Collectively, these definitions and theories illustrate that creativity is not a fixed trait but an emergent, contextually situated phenomenon that involves novelty, value, and a process-oriented approach.

Creativity is negotiated in a social setting

It becomes clear that creativity is less about the production of novel or individual output, and more about the co-created, emergent processes within human relationships. In socially engaged art, the meaning and value of creativity emerge not from an object or performance alone, but also from the interactions and processes of meaning-making that occur among participants. Nicolas Bourriaud's (2002) theory of *relational aesthetics* emphasizes that the aesthetic experience in such practices lies in the 'inter-human relations' they produce. This means that creativity becomes a relational act that is shared, fluid, and responsive, rather than fixed or owned by a single author.

These social relationships are inherently sites of negotiation, especially when situated within creative and community-driven contexts. In participatory art and community-based projects, creativity involves navigating cultural differences, addressing collective concerns, and finding common ground. These negotiations shape both the process and the outcomes of the creative act. Grant Kester (2011) stresses the dialogical nature of socially engaged practices, noting that these interactions are not just supplemental to art but are themselves the medium through which meaning is generated. Therefore, creativity in these settings requires a constant redefinition based on the evolving needs, voices, and perspectives of those involved.

Communities, where these social relationships intensify, rely on creativity not just as a form of expression, but as a critical tool for problem-solving and collaborative decision-making. Creative processes provide space for experimentation and reflection, allowing communities to imagine alternatives, confront social issues, and co-produce knowledge. According to Jeffcutt and Pratt (2002), creativity serves as a form of 'social capital,' (Putnam, 2000) enabling communities to generate shared solutions and innovative approaches to complex challenges. This problem-solving aspect of creativity positions it as an essential component in community development, where its value is measured not by the aesthetic quality of a final product, but by the transformation of relationships and social conditions.

Problem-solving skills in practice: De Warren

Communities like **Woningcooperatie De Warren** in Amsterdam exemplify how intensified social relationships become fertile ground for creativity as a tool beyond mere artistic expression serving as a vital mechanism for collaborative problem-solving and decision-making. At De Warren, residents participate in a co-living model where shared responsibility and transparent communication structures, such as holacracy, foster an environment conducive to collective creativity. As Merel from De Warren explains, 'Holacracy offers a way to organise ourselves that supports transparency, participation, and fluid decision-making, creating space for experimentation and new ideas to emerge' (Merel, interviewed on DeWarren.co). This framework encourages experimentation and reflection, enabling community members to imagine new ways of living together and co-create solutions that respond to their shared needs. As described on Nul20.nl, 'De Warren is a living example of how communities can develop through dialogue and mutual support, where creativity is embedded in everyday cooperation' (Nul20.nl, 2023).

The concept of creativity functioning as 'social capital' (Jeffcutt & Pratt, 2002; Putnam, 2000) resonates deeply within the De Warren community, where creative engagement strengthens trust, reciprocity, and shared identity among members. As De Warren states in its knowledge bank, 'Our community thrives on the diversity of perspectives and skills, and it is through this collective creativity that we develop innovative solutions to common challenges' (DeWarren.co Kennisbank). Putnam's theory that social capital enables collective action and problem-solving is visible in how residents leverage their varied talents to innovate communal living strategies from collective budgeting and sustainable resource use to conflict resolution and shared governance. This creative social capital not only supports

immediate solutions but also cultivates long-term resilience and adaptability within the community. As Ellen Maassen notes, 'Cooperation built on trust and shared creativity transforms social dynamics, empowering communities to face complex issues collaboratively' (Maassen, 2023).

Ultimately, De Warren's approach to community development reflects the understanding that the value of creativity lies not in producing a final aesthetic product but in transforming relationships and social conditions. The community's practice embodies a 'living laboratory of cooperative innovation,' where ongoing negotiation and reflection are central (Cooplink.nl, 2023). As highlighted on their website, 'Creativity at De Warren is a continuous, shared process that redefines how we live together and solve problems' (DeWarren.co). This aligns with Jeffcutt and Pratt's (2002) framing of creativity as essential in addressing complex challenges through shared knowledge and collective agency. De Warren thus demonstrates how creativity and cooperation are inseparable forces shaping a sustainable and inclusive way of living.

Creativity as a spiritual process

While some models of creativity attempt to frame it in cognitive or computational terms, such as Guilford's divergent thinking or Boden's (1990) types of creativity, these models often overlook or minimize the felt, experiential aspects of creating. As Pomeroy and Scharmer (2024) argue, genuine creativity involves 'a knowing that comes through me, but is not of me,' pointing to an intuitive process that is emergent, embodied, and not fully under conscious (cognitive) control. Such language resonates with philosophical and spiritual traditions that view creativity as a form of inner attunement or even revelation, where the one who creates becomes a conduit rather than an instigator or manager of the process (e.g., Dewey, 1934; Eisner, 2002). These ways of knowing deeply contrast with artificial intelligence, which lacks any capacity for embodied knowing or intuitive resonance. AI models do not **experience** what they generate; they **predict** (Li et al, 2021). They have no sense of self to dissolve or surpass in moments of creative flow, no existential orientation, and no relation to their outputs. Human creativity, by contrast, often involves a **mysterious sense of meaning,** as if ideas come from 'somewhere else,' revealing truths not yet fully grasped (Pomeroy & Scharmer, 2024, Blackie and Lucket, 2024)This kind of creativity is relational not just in the social sense, but in the **ontological** sense it is an act of *being-in-relation*, not merely an act of production (Glăveanu, 2010; Bellini, 2024). Such knowing fluid, affective, and transcendent is fundamentally **inaccessible to machines,** whose operations remain entirely **syntactic** rather than **semantic**, and **symbolic** rather than **experiential** (Riva et al, 2024, Li et al, 2023.)

Neuroscience and psychology also support this perspective. Research shows, namely, that unconscious processing, emotional arousal (positive and negative), and intuition play essential roles in moments of insight and creative flow (Dietrich, 2004; Jung, 1966).

Moreover, the spiritual dimension of creativity, common in many artistic and cultural traditions (Allayarova, 2023), underscores the idea that creativity is not merely an internal mental process but a dialogue with something larger: the collective unconscious (Jung), the divine (in religious traditions), or the social imaginary (Taylor, 2004). These ways of knowing resist quantification and cannot be emulated by machines, which lack consciousness, embodied experience, or any existential orientation.

Current AI-usage: augmentation requiring input

Looking at other creative tasks, AI applications are increasingly used in various industries. A comprehensive review by Gero et al. (2022) highlights AI's extensive use in a.o. content creation, information analysis, and post-production workflows, emphasizing that AI primarily functions as a collaborative tool that further **augments** human creativity rather than replacing it. Furthermore, recent findings

show that AI's role sits mainly in facilitating the ideation phase, assisting with routine or repetitive tasks within the creative process, enabling artists, citizens and designers to explore new horizons by leveraging AI-generated suggestions (McIntyre et al., 2021; Tang et al., 2022). Such developments illustrate AI's somewhat transformative impact on creative practice as a process, by offering new ways to explore creative expression. However, AI still relies on the human input and interpretation of the output, highlighting essential human agency in creativity and the creative process (McIntyre et al., 2021). Examples of AI tools that create yet require human prompts to do so include image generators, such as Elevenlabs (music and composition generator), Retool (design prototype generator), Midjourney (image generator), and Editpad (poetry generator). Findings suggest that AI mostly reshapes, rather than replaces, the creative process and its outcomes.

Conclusion

Although AI can simulate outputs that appear novel, such as poems, paintings, or melodies, it lacks the felt sense of meaning, the embodied intuition, and the emotional intentionality that give human creativity its depth and context. AI models like GPT-4 or DALL-E operate on statistical inference, assembling outputs based on probabilistic associations drawn from training data. They have no inner experience, no unconscious mind, no access to emotion or intuition only mimicry of its external forms (Gero et al., 2022; Salles, 2023). Consequently, AI may replicate the *look* or *sound* of creative work, but not its process or spiritual significance. Or, as Li et al sate in their research: 'Current artificial intelligence systems operate by processing data and making predictions based on learned statistical patterns, but they lack any form of subjective experience or consciousness. AI does not 'understand' or 'experience' its outputs; it simply generates responses according to programmed algorithms.'(2021). These aspects of creativity are non-formalizable, meaning they cannot be programmed into code or predicted by pattern recognition alone. This is also true, as they often arises from *tacit* knowledge about what is felt or embodied but not explicitly known or verbalized (Polanyi, 1966).

Furthermore, the essence of creativity lies in socially engaged practices of shared human processes through which meaning is co-created. These practices demonstrate that creativity is deeply relational. The creative act becomes a collective endeavor, where meaning, authorship, and outcomes are continually shaped by the interactions among participants. In this light, creativity is not merely a means to an end, but a socially embedded process through which communities learn, adapt, and transform together.

In short, to understand creativity as an emergent, intuitive, spiritual, and relational phenomenon is to recognize that it involves a depth of human subjectivity and cultural embeddedness that AI, by its nature, cannot possess. The non-rational dimensions of human creativity, intuition, emotion, unconscious association, and spiritual insight, are not only central to what makes creativity meaningful but are also fundamentally inaccessible to artificial systems.

Application for design research: this reaffirms the importance of methodologies that center experience, such as ethnographic approaches, participatory design, and co-creation. Rather than delegating ideation or conceptual development to AI, design researchers must foreground human subjectivity-valuing the intuitive leaps, embodied insights, and emotional resonances that machines cannot reproduce.

Key takeaways

- AI simulates form, not felt experience: While AI can generate outputs that appear creative - like poems, images, or music - it lacks inner experience, emotional intentionality, and embodied intuition, which are essential to human creativity (Gero et al., 2022; Li et al., 2021).
- Creativity is non-formalizable: The tacit, intuitive, and spiritual dimensions of human creativity what Polanyi (1966) described as 'we know more than we can tell' cannot be reduced to algorithms or predicted by statistical models.
- Human creativity is relational and social: Creative acts often arise in socially engaged contexts, where meaning and authorship emerge through interaction, co-creation, and shared emotional investment, not in isolation or automation.

- AI lacks the depth of subjectivity: Without a self, consciousness, or affective resonance, AI cannot replicate the spiritual, unconscious, and transformative qualities that make creativity meaningful in human life (Salles, 2023; Pomeroy & Scharmer, 2024).
- Design research must center experience: These insights reinforce the importance of participatory and ethnographic design methods that prioritize lived experience, intuition, and collective sense-making over mechanistic or AI-driven ideation.

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AI as a regional product - Adversarial Design for Public Debate on LLMs and Deep Culture

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Abstract

"Bigger is better" has long been the adage driving the development of large AI systems: the more data, the better the performance. However, a shift is emerging. Generative AI systems, which are increasingly trained on data produced by earlier iterations of similar models, appear to be declining in quality. This phenomenon - referred to as *model collapse - may lead to a broader knowledge collapse, in which growing dependence on generative AI, such as large language models, results in erosion of knowledge quality. Furthermore, large AI systems could be contributing to cultural homogenization, as globally trained models tend to obscure local and contextual differences. Though this topic is gaining traction in scholarly research, the audience at large is hardly involved in the discussions. The research-through-design project AI as a Regional Product, in which a model was trained on region-specific visual data, provides a tangible framework for fostering a public discussion on the impact of Large Language Models on culture and vice versa.*

Introduction

Since the first wave of globalization in the 1980s, scholars have warned of the growing homogenization of culture. The increasing global exchange of products, services, and systems, - driven in large part by social media technologies - has been argued to make cultural expressions increasingly alike. Kluver and Fu (2004) define *cultural globalization as the exchange of ideas, meanings, and values in ways that expand and intensify social relationships. Cultural globalization can foster greater understanding and cooperation among diverse cross-cultural groups (Steger, 2017).*

With their Cultural Globalization Index, Kluver & Fu (2004) try to measure how globally culturally integrated countries are. More affluent, English - speaking countries show up higher in their index, which might indicate these countries benefit most from cultural globalization. Conversi (2010) argues that cultural globalization largely amounts to 'Americanisation'. As a consequence, developing regions often consume more cultural content from the global North than they export, reinforcing cultural hierarchies (Kluver & Fu, 2004). According to Appadurai (2024), globalization and the complex interactions between global, national, and local contexts do not necessarily lead to cultural homogenization; rather, there is a kind of cannibalization of similarity and difference, in which both continuously influence one another.

AI & Deep Culture

The developments in Artificial Intelligence (AI) have accelerated and amplified the exchange of ideas and cultural and creative processes (Zeng et al., 2020; McCormack et al., 2019). Liu (2024) finds that AI primarily increases access to knowledge and information, as well as interaction between diverse civilizations.

Critical scholars, see that the current global AI culture is driven by just a few leading countries, dominantly US and China (Brandford, 2023), and that this digital geopolitics (Wong, 2021) is taking over and transforming social and cultural processes, which further reinforces the existing power imbalance surrounding globalization.

For example, studies show that AI-generated suggestions can lead non-Western users to adopt Western writing conventions and values, diminishing cultural nuances and expressions (Agarwal et al., 2025). Farina & Lavazza (2025) refer to the dominant use of English in training LLMS as *linguistic racism, as this is marginalizing minority languages and cultures. Furthermore, numerous scholars have pointed at the fact that LLMS could be amplifiers of stereotypes (Hartvigsen et al., 2022), as well as geopolitical biases, with models favoring specific national narratives (Salnikov et al., 2025).*

As to Thompson, we are captured in a technology-driven culture that is smoothing and squeezing out differences (Thompson, 2025). People and cultures become increasingly alike. Beerends critically refers to this as singularity of sameness (Beerends, 2023). Our technological systems, focused on efficiency, are so well-integrated that they become an indistinguishable part of daily life, leading to a cultural transformation.

Criticism to the impact of AI developments on our culture and behaviour is increasing, with attention to the learning behaviour (Mohale &Suliman, 2025), attention spans (Obaid et al., 2024), social behaviour (Suárez-Carreño, 2023) as well as aesthetics (Donarumma, 2022). Donarumma foresees a culture of corporate aesthetics that echoes the global north. This distracts our attention from "an understanding of artistic intention as a form of collective otherness; that is, artistic intention not as the will of an inspired individual or a powerful AI

system, but as the flow of relations among human and non-humans, existing across generations, cultures and geographies." (Donarumma, 2022, p.2).

Whether AI leads to more diverse interactions or to further homogenization and cannibalization, it is clear that deep learning technologies and culture are deeply intertwined. Blanke refers to this as Deep Culture (2024), stressing the importance to critically question the entangled relationship. As the big data adage is still spreading, with currently also synthetic data being used for training LLMS (Ravn, 2025), the discussion becomes more prevalent. Ravn, referring to Amoore (2023), mentions that these new synthetic data developments, travel into policies, technologies, markets, and social practices and, as a consequence, radically transform our thinking.

System collapse & Knowledge collapse

Newer LLM-models, partly trained with synthetic data, do not always deliver better quality. As the training data of future models are scraped from the web, trained on data produced by their AI-predecessors, they sometimes become of inferior quality. This degenerative process whereby, over time, models forget the true underlying data distribution, is referred to as *Model Collapse (Shumailov et al., 2023; Feng et al., 2024).*

As to Peterson (2025), model collapse could result in knowledge collapse, whereby dependence on Large Language Models may lead to a reduction of knowledge diversity, potentially eroding the richness of human understanding and culture. AI-generated content tends to converge toward the average or most common outputs, potentially stifling innovation and cultural variety if people rely too heavily on these systems.

Recent research indicates that mitigating both knowledge and model collapse as AI systems become more embedded in knowledge production will depend on actively managing these dynamics, by being collapse-aware (Dohmatob et al., 2024, 9; Peterson, 2025). Particularly by fostering diversity in training data and promoting critical human engagement throughout the design and deployment process.

From a technological approach, Keisha et al., (2025) describe three stages of Knowledge Collapse, when they reflect on cases of AI Model Collapse: Stage A (Knowledge Preservation) represents reliable factual accuracy with high instruction adherence; Stage B (Knowledge Collapse) demonstrates the critical transition where factual accuracy deteriorates while task format adherence persists, the "confidently wrong" phenomenon where models produce well-formatted but factually incorrect responses; Stage C (Instruction-following Collapse) indicates complete breakdown where accuracy approaches.

Taking this technical, empirical assumption and translating it to a human and theoretical context, knowledge collapse in social groups happens when people keep following routines, while their actual understanding quietly falls apart. In the initial stage, individuals or groups maintain both factual accuracy and adherence to social or professional norms, akin to Stage A in AI systems. As the collapse begins (Stage B), factual reliability deteriorates due to factors such as misinformation, outdated paradigms, or institutional inertia, while actors continue to follow established communicative formats and behavioural scripts. This results in a "confidently wrong" dynamic, where individuals express ideas with rhetorical fluency and structural correctness, yet the underlying content lacks validity. In the final stage (Stage C), even the normative frameworks that guide behaviour begin to disintegrate, leading to confusion about roles, standards, and epistemic authority. This progression suggests that social systems may experience a form of latent epistemic decay, where the persistence of form conceals the loss of substance - until both collapse.

This perspective illustrates a need for a counter-response to epistemic erosion by designing a hyperlocal AI-systems that resists the procedural sameness of large models, aiming instead to preserve culturally specific knowledge and visual integrity (Donarumma, 2022).

Public Debate through adversarial design

While topics as the uniformization of culture, system & nowledge collapse (in all the aforementioned three stages), and more in general the intertwined relation of LLMS and 'a culture of seamless', are gaining traction in academic research, there is hardly a public debate on these issues (Raley, & Rhee, 2023). Given that these are complex and abstract issues, and considering that the general public lacks sufficient AI literacy (Brauner et al., 2025), only a limited number of individuals are actively engaging in a more critical discourse.

Brauner et al., (2025) reveal significant differences in how the general public and AI experts perceive AI's risks and benefits, indicating a gap in understanding that may hinder informed public engagement. Therefore, the researchers express the need to foster a public debate that better includes individuals' attitudes and judgments about risks and benefits that are shaped by affective, cognitive, cultural, and emotional factors.

DiSalvo outlines how *adversarial design (DiSalvo, 2015) can be a meaningful method to enhance this public debate, as these designs intentionally provoke users to reflect on social and ethical dimensions of technology and take affective, cognitive, cultural, and emotional factors into consideration. DiSalvo defines adversarial design as a way of inquiry. "A process of skilled examination and reconstruction renders problematic situations sense-able" (2015, p. 116). With the word skilled, DiSalvo stresses the importance of thought and action in debates. This highlights what design can contribute to public debate: its tangible nature provides a concrete, visual means to engage with complex issues. With sense-able, DiSalvo mentions that the adversarial practices give form to discussions that are hard to grasp. Furthermore, it creates space for emotions to enter the debate as legitimate and productive forces.*

Discussing the impact of AI on culture and vice versa, is not just a matter of rational minds exchanging ideas, but also of bodies, feelings, and affective experiences interacting in the public sphere (Machin, 2022). Emotions express what really matters to people, therefore it's vital, to include these in the public debate. Adversarial design offers a means to do so.

Because of its provocative nature, adversarial design materializes disagreement through artifacts, interfaces, and experiences. By doing so, it invites the public to interpret, critique, and take a stance toward these developments, thereby fostering more critical forms of public engagement (Arets, 2024).

AI as a Regional Product

With the project *AI as a regional Product, Utrecht-based critical medialab SETUP, known for its provocative and adversarial designs, explored how a hyperlocal AI generator could be meaningful in enhancing the public discussion. They took the following design research questions as a starting point: how can the making of an alternative, regional AI system support the public discussion around these developments?*

The design researchers and AI developers of SETUP created a hyperlocal AI image generator StuntyAI. The system was trained based on 26,104 photos taken between 2002 and 2007 at a local Discotheek De Stunt in Epe. StuntyAI proved to be far from "perfect" from a pure technological perspective. The pictures, the system was trained with, vary in size, quality, and perspective. The wide variety of the photos gathered, proved to be a stumbling block for training the AI system. However, there is a stark difference between the images generated by StuntyAI and commercially available Image generators, like StarryAI, see image 1 & 2).

Figure 1: StarryAI generated image with prompt: "Photo of three teenagers on a saturday night at disco "De Stunt" in Epe, the Netherlands in 2003." https://www.setup.nl/app/uploads/2023/09/Stunty-AI-2.jpg

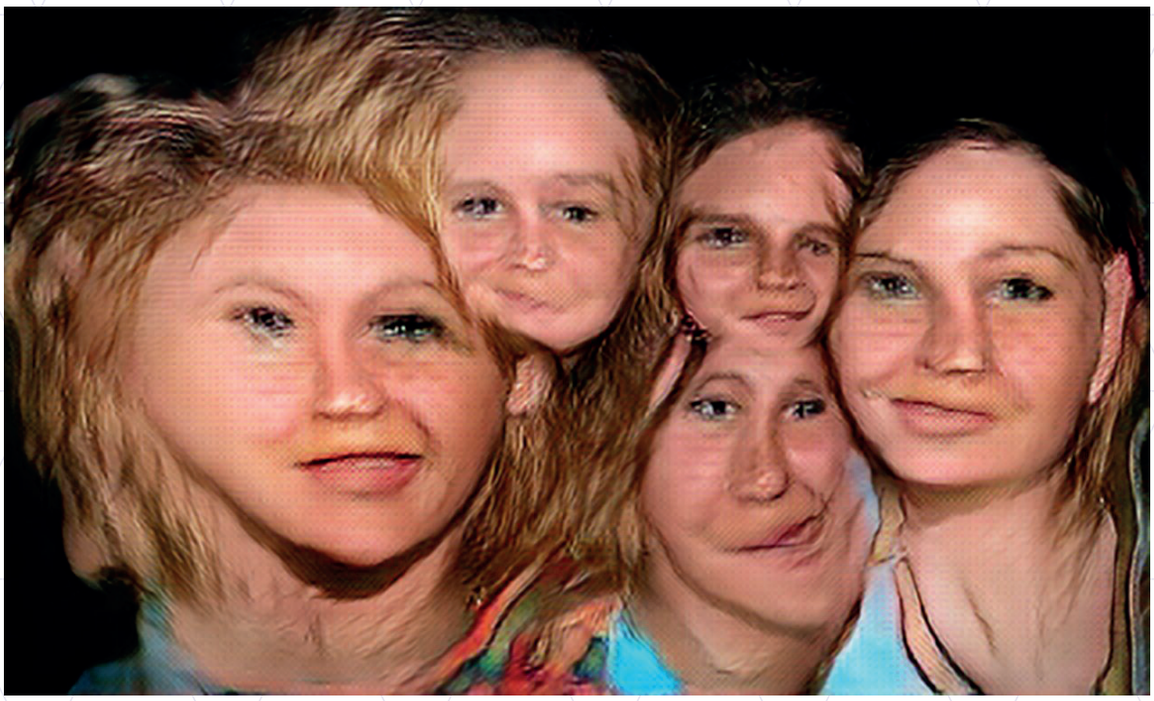

Figure 2: Image2 generated with StuntyAI.
https://www.setup.nl/app/uploads/2023/06/Stuntyai-1280x768.jpeg

The faces that StarryAI generated based on the prompt “Photo of three teenagers on a Saturday night at disco ‘De Stunt’ in Epe, the Netherlands in 2003” are much more realistic. And yet, those images aren’t quite right either. The smooth skin, the clothes without a trace of sweat, the shiny hair - they don’t come from the reality of a sweaty Disco in Epe. The oddly shaped faces from StuntyAI come much closer to that. An imperfect technical implementation proved to be a more authentic representation of Discotheek de Stunt in Epe.

The project was showcased at the science festival *Betweter in Utrecht (September, 20235), where people could tinker and interact with the system, meanwhile discussing its generative outcomes, with the SETUP design researchers.*

Figure 3: installation Stunty AI SETUP at Betweter festival Utrecht

Figure 4: visitors reenacting and being photographed at the images presented at Betweter festival.

Learnings

Through the public interactions with StuntyAI, SETUP concluded that people struggled with the regional AI-system, given its imperfections. Most users have become accustomed to AI images and the homogenized culture present in generated images.

The images produced by the SETUP system were initially perceived as “incomplete” or “inferior” to what commercial alternatives can generate. But the authentic feel and nostalgic theme proved to be enough of a lure to interact with these images, as well as for the audience to reflect on the aspect of ‘aesthetic quality’.

Through tinkering with these imperfect systems, people become aware of AI structures and limitations. Tangible interactions enhanced deeper understanding and support reflection on the socio-cultural impact these systems have (Arets, 2024).

People interacting with the SETUP regional AI system began to understand the possibilities of creating a regional AI- system. The local context offered, made them aware of their role within these developments. This aligns with Hsu et al., who stress the need for systems that are deeply embedded in local contexts on a social, cultural, and environmental level (Hsu et al., 2021). In line with the Community Citizen Science (CCS) framework of Hsu & Nourbakhsk (2020), AI becomes not just a technical artifact, but a situated infrastructure shaped by and responsive to the lived experiences of specific populations. The CSS framework advocates for co-creating AI systems with local communities to address hyperlocal concerns and builds on community-based participatory research, where citizens directly engage in gathering data and extracting knowledge from this data (Hsu et al., 2021). The regional AI system of SETUP offers a helpful way to do so.

Furthermore, the regional AI system instigated a discussion on power dynamics in AI. Most people are well aware that current AI systems are driven by a handful of tech companies. Understanding and experiencing a locally trained system, makes them aware of ways to mitigate these power relations. This also aligns with DiSavlo’s notion that adversarial design can reveal and question hegemonic relations (2015).

Finally, the regional AI system instigates discussions on regulation. An analogy for this can be drawn from the European Union current protective regulations around agriculture and food manufacturing. There are rules on which additives, pesticides, and practices are permitted to ensure food is safe for human consumption. This is the kind of protection the AI-act can provide. However, next to these regulations, the European Union promotes and protects agricultural products like Cognac, Prosciutto di Parma or Noord-hollandse Gouda. To

protect these regional practices and the culture around food. Currently, there is no policy in place to promote these kinds of AI's practices and protect adjacent cultural expression, which calls for further debate and research.

Discussion

The adversarial design project *AI as a Regional product juxtaposes the narrative of the ever-growing, larger AI models. Models trained on global and larger datasets promising a better general way of generating text, images, music, or other cultural products. Models are fuelled with available data that can amplify current inequalities. Currently these 'flaws' are mitigated by adding data of underrepresented groups or by training systems with synthetic data. However, as this could result in LLMs with inferior quality and even system collapse, which could result in knowledge collapse.*

By highlighting an underrepresented AI practice, namely that of locally-harvested and artisan trained AI, SETUP expanded the narrative around AI and this could support public engagement and a more critical debate on deep culture.

The adversarial design project demonstrates how design can serve as a critical tool for engaging the public with complex issues surrounding power, cultural homogenization, and the legal dimensions of LLm's. However, a key limitation lies in the limited reach of such practices; they often circulate within small, already-engaged communities rather than the broader public sphere. Future research should therefore explore how adversarial design methods might be scaled or adapted to reach more diverse audiences.

Key takeaways

- There is a need for a broader public debate on the impact that large AI systems have on our culture, especially now that newer, larger models often demonstrate a decline in quality. Researchers have warned about the risk of systemic collapse, which could in turn lead to a collapse of knowledge.
- While scholarly attention to these issues is growing, they remain largely absent from public discourse. This lack of engagement stems partly from limited AI literacy among the general population, but also from the absence of accessible, tangible formats for discussion.
- Adversarial design can help address this gap by providing concrete, interactive means to engage with questions of AI quality, the mechanisms underlying these systems, and their broader cultural effects, such as the risks of cultural homogenization and the power dynamics embedded within AI technologies. There remains a challenge of growing the adversarial design practice as well as reaching more diverse audiences.

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‘Bot-iful Accidents’: Can A.I. Spark Serendipity?

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Abstract

Generative systems are rapidly entering studios and classrooms. This prompts a practical issue for applied design research: how do generative tools affect serendipity, the useful and unforeseen turns that can redirect a project for the better? Design education foregrounds reflection in action and tacit knowing, where mistakes and the behaviour of materials trigger reframing and learning (Schön, 1983; Polanyi, 1966). Contemporary tools tend to autocomplete and correct. This paper investigates whether artificial intelligence can facilitate serendipity rather than suppress it, and under what conditions it can achieve this.

Three bodies of work are brought together. First, recommender systems and HCI research evaluate serendipity in terms of relevance, usefulness and unexpectedness rather than novelty alone, warning that it is easy to simulate surprise without deepening understanding (Kotkov, Medlar, & Głowacka, 2023; Reviglio, 2024; Ziarani & Ravanmehr, 2021). Second, studies of mixed initiative co creativity and human centred explainability indicate that probeable and scrutable systems can widen horizons while keeping designers in charge (Abdul et al., 2018; Ehsan & Riedl, 2019; Liao, Gruen, & Miller, 2021; Lin et al., 2023; Zhu et al., 2018). Third, surveys of model hallucination map where distortion is harmful and show that, in low risk exploration, clearly labelled what if suggestions can operate as productive provocations when uncertainty and provenance are explicitly presented (Huang et al., 2023; Ji et al., 2022; Sun et al., 2024).

Building on this synthesis, we set out practical guidelines for serendipity by design organised around three pillars: horizon widening with guardrails, sense making through visible seams, and situated responsibility. We operationalise these through two lightweight instruments, detour ledgers and provocation slots, together with advisory serendipity probes for critiques. A short vignette from dementia care shows how the approach reframes success from the speed of advice to the quality of supported judgement. We conclude that when interfaces surface uncertainty and provenance, and when assessment rewards both exploration and polish, the combination of algorithmic breadth and human depth keeps meaningful serendipity alive in everyday design.

Introduction

Generative systems are rapidly entering studios and classrooms. This prompts a practical issue for applied design research: how do generative tools affect serendipity, the useful and unforeseen turns that can redirect a project for the better? Design practice often invites productive mistakes, beautiful accidents. An awkward sketch can reframe a brief, a misregistration can become a motif, and a contradictory user statement can open a new line of inquiry. Design education foregrounds reflection in action and tacit knowing, where mistakes and the behaviour of materials trigger reframing and learning (Schön, 1983; Polanyi, 1966). The question for this contribution is whether contemporary generative systems, which aim to autocomplete and correct, can still support such detours, or whether they compress ambiguity and reward surface fluency.

The stakes are both practical and conceptual. Studios are under pressure to deliver quickly, students learn in environments shaped by tool defaults, and organisations increasingly equate smoothness with quality. In this setting, friction and difference are easy to iron out. Yet many consequential advances begin as rough edges that resist smoothing. Suppose generative systems narrow the middle of the process where comparison, doubt, and re-interpretation occur. In that case, the discipline risks losing a source of originality that cannot be scheduled or forced. If, however, these systems can be configured to widen horizons, expose their seams, and invite scrutiny, they may help designers notice possibilities they would otherwise miss. This paper examines the conditions under which serendipity remains possible with such tools in the loop and what it takes in terms of interaction design, pedagogy, and governance to maintain recognition and responsibility in human hands.

Core concepts

Serendipity is commonly defined as an unexpected yet valuable discovery (Merton, 1948). In digital settings, surprise is easy to produce, while value is contextual and hard to measure. Recommender systems research, therefore, evaluates serendipity as a combination of relevance, usefulness, and unexpectedness rather than novelty alone (Kotkov et al., 2023; Ziarani & Ravanmehr, 2021). Perceived serendipity is sensitive to task framing and prior exposure, which cautions against metric-only approaches that ignore situated goals.

Reviglio (2024) complements this view with a taxonomy that contrasts hyper-personalized suggestions, which optimize fit but narrow horizons, with more divergent, pseudo-personalized recommendations, which broaden horizons but can reduce perceived fit. He warns about fake or manipulative serendipity in engagement-driven platforms. Two implications follow for applied design. First, serendipity is situated and value-laden. Second, serendipity is recognised rather than manufactured. Tools can widen the search space, but whether a detour matters requires human discernment and shared criteria.

Tacit knowledge underpins recognition. Polanyi (1966) argues that practitioners possess more knowledge than they can articulate explicitly. Studio pedagogies build on this insight and reward learning and reframing rather than surface polish. Default behaviours that autocomplete, upscale, and harmonise can compress the ambiguous middle where sense-making and reframing occur. There is countervailing evidence from co-design. Generative image tools, when used with care to regulate affect and limit fixation, can externalise tacit knowledge and deepen discussion (He, Xiao, & Xie, 2024). At the same time, ambiguity, deliberately maintained, offers a resource for interpretation and reflective practice (Gaver, Beaver, & Benford, 2003). For the early-stage use of generative tools, this implies that outputs should resist over-resolving uncertainty, allowing interpretive work to remain possible.

Research questions

- *Under what interaction patterns and governance can generative systems support meaningful serendipity in applied design, without sacrificing human agency, team diversity and responsibility ?*
- *How can serendipity be made operational for critiques and reviews so that it can be recognised, recorded and acted upon rather than left to chance ?*
- *Which practical instruments help designers and students invite relevant difference while controlling risks from distortion, homogenisation and premature convergence ?*

Relevance and scope

The enquiry matters because tools that optimise for speed and polish can unintentionally suppress the reflective detours that lead to better outcomes. For designers, the risk is premature convergence on familiar solutions. For design researchers, the challenge is to name, observe and measure meaningful surprise in ways that travel across projects. For students, the task is to learn disciplined strategies for divergence and critique. The scope here is early and mid-stage conceptual design, co-design with stakeholders, and educational studio work where exploration is safe and reversible; high-stakes clinical or safety decisions remain out of scope.

The argument advanced is that artificial intelligence can support genuine serendipity when interaction and governance are designed to facilitate it. We synthesise research on how to define and evaluate serendipity, drawing on mixed-initiative co-creativity and human-centred explainability to propose patterns that preserve designer agency, and treat model fallibility as a possible source of useful provocation in low-risk contexts. Recent practitioner studies report a mixed picture. Designers describe gains in speed and coverage, while also expressing concern about control and quality when adopting generative tools (Uusitalo, Lovejoy, & Salovaara, 2024). Experimental studies indicate that access to machine suggestions can boost individual creativity, while narrowing the variety of outcomes across teams (Doshi & Hauser, 2024). Read together with practitioner reports, this pattern strengthens the case for deliberate interaction design, rigorous evaluation and clear governance.

Methods for Practice

Prompt-and-reply interaction keeps initiative with the user at the moment of prompting and with the model at the moment of output. Mixed-initiative co-creativity spreads initiative over time and makes the system probeable. Lin et al. (2023) map a design space for such systems and find that broader coverage of interaction types relates to higher perceived creative support, with scrutability as a critical dimension. In this spirit, human-centred explainability replaces opaque confidence scores with rationales, counter-rationales and contrasted alternatives that fit designers' mental models and support judgement in context (Abdul et al., 2018; Ehsan & Riedl, 2019; Liao et al., 2021). Practice-oriented approaches make this concrete for day-to-day work, offering implementable steps and checkpoints rather than abstract principles. For instance, DesignFusion weaves multiple generators into early concept development through transparency steps and deliberate designer interventions (Chen, Li, Zhu, & Wang, 2024); an AI-UCD process links needs assessment, ideation and continuous validation with explicit ethical checks (Siricharoien, 2024). For text-to-image tools, UX heuristics that show why elements appear help designers refine intent rather than guess (Vacanti, Paynter, Murgia, & Moggridge, 2024).

In consequential domains, model hallucinations are unacceptable and require controls. Surveys outline forms and harms and recommend guardrails such as retrieval grounding, clear uncertainty communication and domain constraints (Huang et al., 2023; Ji et al., 2022; Sun et al., 2024). In exploratory design, the same phenomenon can sometimes serve as a contained provocation if it is explicitly flagged and kept within a sandbox. The practical task is to separate potentially fruitful what-if suggestions from misleading claims. Interfaces should surface uncertainty cues, show provenance for any factual statement and provide clearly labelled wildcards that invite inspection rather than deference.

Teams also need reliable ways to notice and assess meaningful surprises. Tokutake and Okamoto (2024) show that large language models can assist in labelling serendipitous recommendations, yet alignment with human judgement is moderate and context dependent. This supports the use of serendipity probes as advisory instruments rather than as decision makers. In sprint practice, a probe can pre-rank candidate directions by expected surprise relative to a brief, after which human critique decides whether to pursue or drop the detour and records the rationale.

To make serendipity operational in critiques and reviews, a compact three-part rubric can be applied. Each candidate direction is scored on relevance to stated values and constraints, usefulness for the next concrete step and unexpectedness relative to precedent and team priors. A path counts as a meaningful surprise when it reaches at least medium on relevance and usefulness and at least medium on unexpectedness. Evidence for each score is captured in one sentence alongside the decision taken. Two lightweight instruments embed this into cadence. A detour ledger lists explorations, justifications and keep-or-drop outcomes, normalising small risks and limiting premature convergence. A provocation slot reserves time each sprint for high-variance exploration using oppositional or constraint-based

prompts, followed by a mandatory rationale for adoption or rejection. These mechanisms also counter homogenisation in settings where many teams rely on similar models or prompt recipes; recursive use of generated data can induce model collapse (Shumailov, Shiai, Papernot, et al., 2024).

Dementia vignette design fiction

Imagine a co-design initiative in which family caregivers work towards an AI-enabled decision aid for night-time agitation in dementia. The first round of interviews might expose areas of doubt concerning medicines, sleep practices and situational cues. To externalise tacit knowledge, the team would translate short caregiver narratives into concise prompts. These prompts could generate simple images and text sketches that anchor discussion without prescribing solutions. Motifs such as blurred clocks and dim corridors might provide a shared backdrop for conversation. Following He, Xiao and Xie (2024), facilitation would alternate between evocative imagery to help name affect and neutral sketching to limit fixation.

In a scheduled provocation slot, the group could request alternatives that contradict current assumptions. One candidate would replace automated advice with reflective prompts, asking caregivers to rate their confidence and annotate context before any suggestion appears. An advisory serendipity probe might score this flow high on unexpectedness and moderate on relevance, flagging it for critique. Caregivers could argue that a reflection-first sequence helps temper over-reliance on automation when stress and risk are elevated.

If the team were to adopt this detour, they would add a guardrail. When risk signals are detected, the interface would default to reflection-first mode, and any retrieved guidance would appear with clear provenance and applicability notes. Over time, success could shift from the speed of advice to the quality of supported judgement, as caregivers become more confident about when to follow or ignore suggestions and why.

Guidelines for serendipity by design

Considered together, the literature and the vignette support a practical view: serendipity is not mere luck but something that can be deliberately cultivated through interaction patterns, team rituals and governance choices. To make this workable, we frame three pillars that offer clear concepts and practical entry points. Each pillar links a guiding aim to concrete mechanisms that can be taught in studios, audited in projects and adapted to organisational constraints. Together they offer a way to widen horizons without losing control, to turn surprise into understanding and to anchor responsibility where it belongs.

- Horizon widening with guardrails. Increase encounters with relevant difference rather than noise. Mechanisms include divergence blocks that pair fit oriented and stretch oriented prompts, oppositional prompts that deliberately violate current assumptions and advisory serendipity probes. Guardrails include value based relevance filters derived from stakeholder criteria and context, while monitoring for fake serendipity and homogenisation (Doshi & Hauser, 2024; Kotkov et al., 2023; Reviglio, 2024).
- Sense making through visible seams. Turn surprises into insight through explanation, provenance and comparison. Practical levers include explanation patterns that provide rationales alongside counter proposals, indicators that make confidence and provenance visible, and versioned detours that document learning and show how it informed decisions (Abdul et al., 2018; Ehsan & Riedl, 2019; Liao et al., 2021; Zhu et al., 2018). For text to image systems, UX heuristics that show why elements appear help designers refine intent rather than guess (Vacanti et al., 2024). DesignFusion offers transparency through clear steps and points of intervention in the early conceptual phases (Chen et al., 2024). An AI UCD process situates such tools within end to end user centred cycles with ethical checks (Siricharoien, 2024).

- Situated responsibility. Amplify beneficial surprise and constrain harms. Mechanisms include participatory audits and value sensitive defaults that make stakeholder values explicit, combined with internal algorithmic auditing for go or no go decisions (Friedman & Hendry, 2019; Raji et al., 2020). Education should cultivate arbiters who judge which surprises matter and integrators who embed capabilities responsibly. Studies of prompting indicate that strategy matters for discovery and that oppositional or constraint based prompting can widen horizons while maintaining control (Almeda, Zou, Yang, & Kim, 2024; Oppenlaender, Tola, & Gonçalves, 2023). Professionals often view these tools as assistive, while warning about the risks of skill degradation for juniors who over rely on automation (Li, Liu, Ravichander, & Choi, 2024). Studio experiments demonstrate a broader conceptual range when students learn to critique and iterate rather than accept initial suggestions (Abrusci, Imperato, Ceglia, & Frangipane, 2025).

Conclusion

Used at default settings, generative systems can narrow ambiguity and reward polishing. Under mixed-initiative configurations that widen horizons, reveal seams, and keep humans responsible, algorithmic breadth combined with human depth can produce discoveries that neither could achieve alone. The practical task is to make detours a first-class feature through interfaces that sustain ambiguity, workflows that pause for reflection, and evaluation criteria that reward learning. Under these conditions, serendipity can be treated as an emergent property of hybrid cognition that is compatible with rigour and responsibility. With A.I., designers can remain actively in the loop, probing, judging, and caring; failing forward towards 'bot-iful accidents'.

Key takeaways

For designers, design researchers, and students, the practical implications of using generative systems can be summarized as follows.

- Treat serendipity as relevance, usefulness, and unexpectedness rather than novelty alone.
- Prefer mixed-initiative dialogue with scrutability to facilitate prompt and responsive interactions.
- Display uncertainty and provenance, and use clearly labeled 'what if' sandboxes in exploratory work.
- Use serendipity probes as advisory instruments and route candidates into critique.
- Reward learning and reframing to counter premature convergence and homogenisation.

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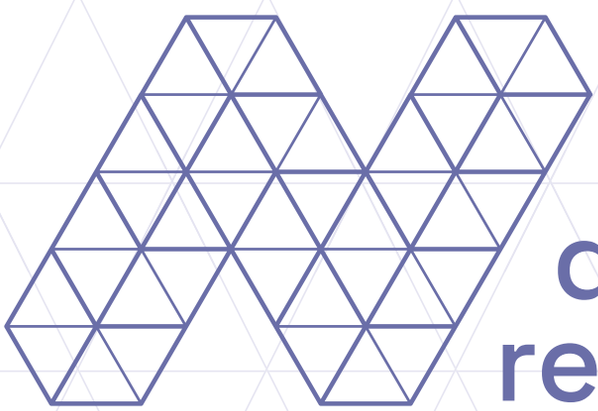

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