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Navigating AI in Design Education: A Student-Led Reflection on AI as a Tool in the Creative Process

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Abstract
The rapid advancement of artificial intelligence (AI) technology is disrupting and reshaping both professional design practice and design education. While AI-driven generative tools offer new possibilities in the design process, questions remain about their broader impact on creative processes, authorship, and pedagogical approaches. This paper presents findings from the first cycle of an Action Research project investigating the perceived benefits and challenges of integrating generative AI tools into the design process and design education. In this pilot study, 10 postgraduate industrial design students were tasked with completing a speculative design project in which they were challenged to envision possible futures where humans, technology, and the environment coexist harmoniously. Following the Double Diamond design process model, the curriculum-based project was structured to explicitly integrate generative AI technology as a primary tool in the visualisation and delivery phase (second diamond) of design outcomes. Students were required to accurately document and critically reflect on their experiences using AI in their creative process. This paper presents key findings and themes derived from a thematic analysis of student reflections and lecturer observations on the use and effectiveness of AI in a speculative design project. Initial findings highlight both the potential and limitations of AI in design. While AI enhances efficiency and expands creative possibilities, it lacks human intuition, emotional depth, and cultural nuance. Overall, this paper captures student perceptions of the impacts of AI on the design process and underscores the need for critical engagement with AI in design education. It concludes with recommendations for future research, including subsequent Action Research cycles and related projects, to further refine and expand on these initial findings.

Keywords: AI, design process, Double Diamond, industrial design, education.

1. Introduction

"*The future of higher education is intrinsically linked with developments in new technologies and computing capacities of the new intelligent machines*" (Popenici & Kerr, 2017, p. 1). As design educators, we find ourselves in an era of unprecedented transformation, and the multifaceted consequences of using artificial intelligence (AI) for academic purposes are a topic of much debate and concern in academic institutions. We are grappling with questions such as: Should AI be embraced or resisted in design

classrooms and studios? How does AI influence creative autonomy and innovation in the design process? Will AI tools make designers obsolete?, and, perhaps most notably: How can educators navigate this rapidly evolving and uncertain landscape in the way we facilitate and deliver teaching? AI is a powerful tool with significant potential to enhance student learning (Bauer et al., 2025). However, uncertainty regarding its broader impact remains, with many being concerned that AI poses a serious threat to effective teaching and learning (Michel-Villarreal et al., 2023).

This study is the first cycle of an Action Research project exploring how designers might effectively leverage AI as a tool in the design process without compromising outcomes or their learning and skills development. The research aims to contribute to discourse by making recommendations on when and how generative AI tools can be best integrated into design practice and education. This paper specifically presents a postgraduate industrial design project that was structured to actively and openly integrate generative AI technology into the design process. Students were required to document and critically reflect on their experiences of using AI in their creative process, and to identify effectiveness, limitations, and ethical considerations of using AI in the design process.

This paper contextualises the study through a review of existing literature on AI in the design process and higher education, followed by an outline of the research methodology and project design. It then presents key findings and themes derived from student and lecturer reflections on the effectiveness of AI in the later stages of the design process. The paper concludes with a discussion of these findings, alongside recommended strategies for the effective and ethical integration of AI into the design process, as well as directions for future research.

2. Contextualisation

AI in Higher Education

According to constructivist theory, education is an active process involving the construction of knowledge through autonomous and active learning (Hasanein & Sobaih, 2023). According to Bauer et al. (2025), education fundamentally aims to "*optimise cognitive outcomes, specifically, the acquisition of knowledge and the development of skills*" (p. 3). Education is, at its core, "*a human-centric endeavour, not a technology-centric solution*" (Popenici & Kerr, 2017, p. 3). Effectively teaching or transferring knowledge and skills to prepare individuals to tackle complex real-world problems requires engaging them in meaningful, cognitively challenging learning experiences (Bauer et al., 2025, p. 5). A key concern with the use of AI in educational settings is its potential to hinder the development of essential knowledge and skills through the elimination of "deep learning processes", where students synthesise, evaluate, and integrate new and existing knowledge (Bauer et al., 2025, p. 5).

Bauer et al. (2025, p. 9) identified two key effects of AI use in education: *substitution* and *inversion*. Substitution refers to AI use that improves efficiency in the delivery of instruction equivalent to non-AI methods without affecting the depth of cognitive processing or learning outcomes (Bauer et al., 2025, p. 9). Inversion, on the other hand,

occurs when AI, intended to enhance learning, instead reduces cognitive engagement and learning outcomes, undermining its intended benefits (Bauer et al., 2025, p. 9). This dual nature of AI in academia is becoming increasingly evident. While AI can greatly enhance efficiency, it also poses significant risks to learning (Zhai et al., 2004).

When reflecting on the publication boom in the field of AI in education, the key concerns raised unanimously include overreliance, compromised academic integrity, plagiarism, lack of quality and accuracy, compromised learning outcomes, bias, and student-skillset depletion (Hasanein & Sobaih, 2023; Zhai et al., 2004). Authentic learning experiences, such as engaging with content and interacting with instructors and peers, are essential for a comprehensive and meaningful education (Michel-Villarreal et al., 2023, p. 8). It is noted that an overreliance on AI may cause reduced cognitive engagement and negatively impact students' transversal skills, such as critical thinking, problem-solving, communication, creativity, and decision-making, diminishing their capacity for exploration and analysis (Bauer et al., 2025; Hasanein & Sobaih, 2023; Michel-Villarreal et al., 2023; Zhai et al., 2004). When students use AI with "metacognitive laziness" (Bauer et al., 2025, p. 11) or accept AI-generated recommendations or outputs as fact, without critical reflection (Zhai et al., 2004, p. 7), they miss essential learning opportunities by not engaging deeply in self-regulated learning processes (Bauer et al., 2025). This consequently undermines their ability to analyse and grasp the information independently, impairing their development of transversal skills (Zhai et al., 2004).

Beyond the loss of deep learning, when students rely on AI to produce work without genuine input, it compromises academic integrity and fairness in assessment, creating further ethical hurdles for assessors and lecturers (Hasanein & Sobaih, 2023, p. 2599). Concerns related to accuracy and reliability arise from algorithmic biases (Lee et al., 2025; Michel-Villarreal et al., 2023; Zhai et al., 2004). AI models can perpetuate the biases and prejudices present in their training datasets in the content they generate. When students fail to critically evaluate or cross-verify the content they receive, they may mistakenly regard these biased outputs as the objective truth (Zhai et al., 2004) and unintentionally reinforce these biases, especially in the context of sensitive or controversial topics (Bauer et al., 2025; Hashem & Hakeem, 2024; Hasanein & Sobaih, 2023; Michel-Villarreal et al., 2023).

AI in Industrial Design

The field of industrial design, like most design disciplines, is undergoing a significant transformation due to the rapid advancement of AI (Tang et al., 2024). Design is a discipline strongly related to creativity, which has traditionally been regarded as an exclusively human ability. However, the advancement of AI has begun to challenge this notion (Chulvi, 2025, p. 2). The conversation is quickly shifting from viewing AI as a tool for automating simple tasks to viewing it as a creative collaborator in the design process (Villalba & Palomar, 2024). Generative AI uses neural network algorithms to create new content. It is transforming design by enabling faster exploration and development of a wider range of concepts, opening new frontiers for innovation, efficiency, and creativity beyond traditional methods (Chulvi, 2025;

Hashem & Hakeem, 2024; Villalba & Palomar, 2024). The World Design Organisation (2025) defined *industrial design* as "*a strategic problem-solving process that drives innovation […]. At its heart, Industrial Design provides a more optimistic way of looking at the future by reframing problems as opportunities*".

Concerns regarding the loss of transversal skills and inherent biases are particularly significant when discussing the field of industrial design and its education. Krippendorff (2006) explained that "*design is making sense of things*". Design intuition closely relates to abductive reasoning. Designers engage in reflection-in-action, developing an abstract understanding through direct, concrete interactions with materials related to the design problem (Lee et al., 2025, p. 1). According to Hashem and Hakeem (2024), "*[a] designer's ability to perceive and interpret information affects his or her ability to generate innovative ideas*" (p. 122). The core function of industrial designers is to think critically and problem-solve. In light of this, the above-mentioned concerns of AI overreliance and the loss of these transversal skills are deeply concerning.

Design is a discipline focused on the interaction between users and the human-created environment, considering aesthetics, functionality, context, culture, and society (Villalba & Palomar, 2024). Industrial design is, or should be, human-centred and contextually nuanced. Prejudices and assumptions within the design field can exacerbate social inequalities, resulting in discriminatory outcomes. To ensure that design outputs are appropriate for and truly representative of society as a whole, the design discipline itself must be diverse (Moseley & Campbell, 2019). When this diversity is lacking, the absence of essential tacit insights during the design process leads to underdeveloped products and services that fail to meet the nuanced needs of users (Moseley & Bediako, 2021). As a field, industrial design already contends with issues such as gender and racial disparities in data representation, as well as a history of dominance by white, male, Western perspectives. Although significant strides have been made to address these disparities, the rapid adoption of AI threatens to reverse this progress, as the underlying datasets often remain biased and lack contextual and cultural diversity.

The Role of AI in the Design Process

The integration of AI into industrial design practice presents both significant opportunities and challenges. On the one hand, AI tools can facilitate rapid ideation, visualisation, and optimisation, enabling designers to explore a broad spectrum of ideas at a more rapid pace. On the other hand, AI use can diminish the role of human intuition, creativity, and originality, particularly in the conceptual stages, where individual creativity and tacit knowledge are essential (Tang et al., 2024). AI tools can support designers throughout the design process, from initial problem-framing to the detailed design of a particular solution (Lee et al., 2025). However, the inappropriate use or overuse of AI in the design process could negatively affect the quality and suitability of the outcome or solution. It is therefore important for designers and educators to examine the design process and understand the specific activities and skills required by each stage. This helps determine when and how AI can be most

effectively applied to support their goals without replacing the role of human creativity and judgement (Hashem & Hakeem, 2024).

The UK Design Council's Double Diamond Model (Figure 1) serves as a valuable framework for organising and describing the divergent and convergent activities that occur during the design process. Divergent thinking, involving research, brainstorming, and the generation of varied ideas, empowers designers to explore a wide range of possibilities and uncover unconventional solutions. Convergent thinking focuses on refining and narrowing these ideas to define the problem, identify the most effective options, and arrive at a clear and focused design outcome. Various authors have used the Double Diamond Model to investigate the role of AI in the design process, although opinions differ on which phases AI offers the most value.

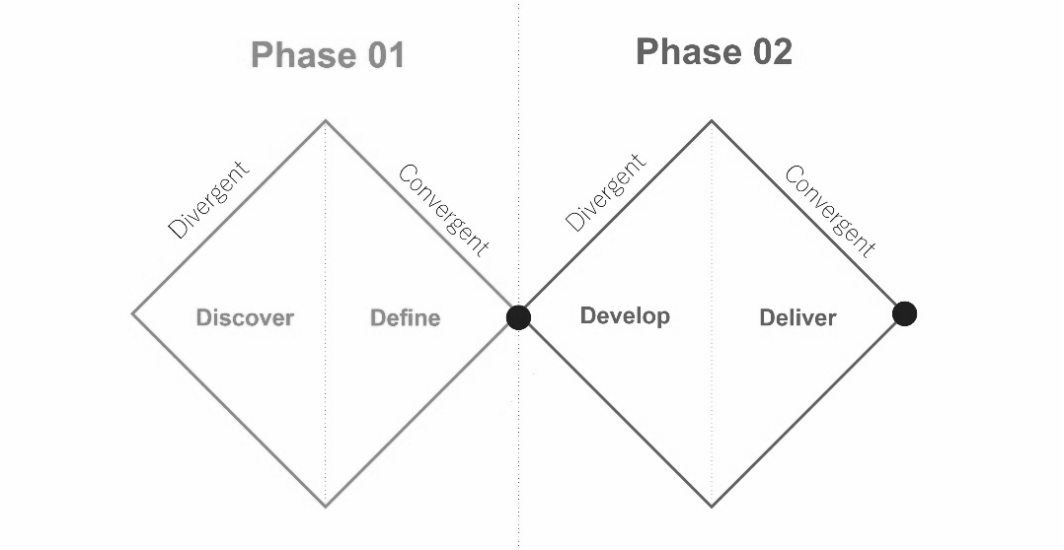

Figure 1: UK Design Council's Double Diamond Model (Illustration by author, 2026)

Tang et al. (2024) argued that the convergent phases can leverage AI effectively to refine ideas. Conversely, in the divergent phases, human creativity, intuition, and manual ideation are essential, applying foundational skills (such as manual ideation and sketching) to establish clear objectives and initial concepts without the constraints that AI might impose. In contrast, Fang (2023) argued that while AI is effective in the divergent stages, allowing for rapid exploration and ideation of varied concepts, the convergent stages are better handled with existing tools and designer expertise and decision-making. A third perspective can be seen in the paper by Lee et al. (2025), titled "When and how to use AI in the design process? Implications for human–AI design collaboration". Lee et al. (2025) conducted an extensive literature review on AI design support systems (AI-DSS) through the lens of the Double Diamond design process framework to understand where and how AI is currently supporting the design process. Rather than comparing divergent and convergent thinking or phases, their findings indicate that up to 70% of current AI systems support designers in the second diamond of the Double Diamond Model. This is in the later stages of the design process, where humans generate and evaluate design solutions (Lee et al., 2025).

The Need for Research in Higher Education Pedagogy

According to Bauer et al. (2025), there is a need for a "*systematic and evidence-based approach to AI in education […] to ensure that AI in education leads to meaningful improvements in student learning outcomes*" (pp. 1, 19). In an independent research report, Mayers (2024) argued that the rapid evolution of technology necessitates a continuous re-evaluation of pedagogical approaches. We cannot ignore the reality that, by the time our students graduate, they will enter a world where AI is actively reshaping and driving the design industry. The rapid advancement of AI and its inevitable impact on the design industry require a transformation of the educational systems used to train the next generation of designers (Tang et al., 2024).

In preparing students for the industry, it is not enough to equip them with context-specific skills and knowledge; they must also develop critical consciousness and the ability to navigate ethical challenges in an industry that is rapidly evolving through technological advancement (Mokgatla & Moseley, 2023). The key questions we must ask are: Where does AI add genuine value to the design process? and: Where might it hinder design outcomes or compromise student learning? Understanding and integrating AI in design education can prepare future designers to harness the capabilities of AI responsibly, maintaining their creative agency and ensuring ethical considerations are integral to the design process (Tang et al., 2024). By integrating generative AI into project-based learning, students can harness its capabilities throughout the design process, and educators can act as facilitators, guiding students in their use of AI tools and promoting thoughtful analysis of the outputs (Mayers, 2024). This critical approach helps students recognise the limitations and biases inherent in AI while building their ability to effectively use AI as a creative partner (Mayers, 2024). AI will inevitably be used, including in inappropriate or deceptive ways. Our responsibility as educators is to guide students towards integrating it thoughtfully, ethically, and with a clear purpose.

3. Methodology

Action Research (AR) is an educational research method that enables educators to examine, reflect on, and enhance their pedagogy and teaching practices (Clark et al., 2020; Sagor & Williams, 2016). As outlined in the literature review, the rapid evolution of AI technology necessitates the continuous re-evaluation of pedagogical approaches (Mayers, 2024). In this context, understanding how to effectively integrate AI into design practice and education is crucial for preparing future designers to harness its capabilities responsibly, while maintaining creative agency and incorporating ethical considerations into the design process. There is therefore a need to critically explore where and how AI adds the most value in the design process, as well as where it may pose potential risks. Such an enquiry is necessary to ensure that the integration of AI into education contributes to meaningful improvements in student learning outcomes and supports the development of appropriate, unbiased design solutions. This paper presents the first cycle of an AR project exploring the possibilities of the integration of AI tools into the industrial design process within higher education.

The larger AR project is guided by the following question: *How and at what stages can generative AI tools be effectively integrated into design education and the design process to support student learning and creative practice without compromising human judgment?* This research aims to contribute to the Scholarship of Teaching and Learning (SoTL) discourse by developing recommendations for when and how generative AI tools can be effectively integrated into design education. It seeks to support meaningful improvements in student learning outcomes while fostering critical consciousness and engagement with AI in the design process.

The study is guided by the following research objectives:

A. Facilitate student design projects that integrate AI tools across different phases of the design process, to assess their advantages and limitations.
B. Gather project reflections from both students and lecturers, encouraging critical reflection on the use of AI in the design process.
C. Analyse student and lecturer perspectives on the effectiveness, limitations, and ethical implications of using AI in design.
D. Develop recommendations for the effective and ethical integration of AI in design education.

This paper specifically presents the first phase and pilot study of the above AR project. The study followed the four steps of AR, namely, *Plan, Act, Observe*, and *Reflect* (Clark et al., 2020). The activities associated with each phase, and their alignment with the research objectives, are outlined below.

The Plan phase focused on the development of the research objectives and methodology, as well as the design of the project brief, including its requirements and assessment criteria. In alignment with Objective A, a curriculum-based project was developed for a cohort of 10 BA Honours Industrial Design students (detailed in Section 4 below). The project was structured to integrate AI tools in the design process to explore their potential advantages and limitations. In the Act phase, the 10 postgraduate industrial design students undertook the project as outlined in the brief. In line with Objective B, the students were required to document their design processes, including their use of AI tools, and to engage in ongoing reflection on the use of AI tools throughout the project. During the Observe phase, the lecturer evaluated the project processes (the use of AI tools) by analysing the students' documentation thereof, and the final design outcomes based on the established assessment criteria. In line with Objective C, qualitative data were collected through written student reflections and a post-project questionnaire. The data were analysed using thematic analysis, involving the identification of recurring patterns and themes, to gain insight into student perspectives on the effectiveness, limitations, and ethical implications of AI in the design process. Finally, in the Reflect phase, the findings were critically reviewed in relation to existing literature. In alignment with Objective D, this phase informed the development of recommendations for the effective and ethical integration of AI in design education, as well as considerations for subsequent iterations of the project and future research.

This methodological approach facilitated an exploration of students' experiences, insights, and challenges using AI in their process (Sagor & Williams, 2016), enriching the broader understanding of the potential for integrating AI into industrial design education.

Ethical Considerations

Ethical approval for this study was obtained from the Faculty Research Committee before the commencement of the research. All procedures were conducted in accordance with institutional ethical guidelines. Students were required to complete the project as part of their coursework; however, participation in the research (including permission to use written reflections, project work, and outcomes) was voluntary. Students were invited to participate using an informed consent form in which they were assured that their academic results would not be affected by their decision to participate or withhold consent, as the research took place after the final project assessment. Participants were given the option to consent to each category of data independently (e.g., project process and outcome images, group reflections, and individual survey responses). All identifiable information was removed to maintain confidentiality, and all participants remained anonymous.

4. Student Project Design

In the context of the Fifth Industrial Revolution (5IR) and an Afrikan-centred approach aligned with the Sustainable Development Goals (SDGs), students were challenged to envision futures where humans, technology, and the environment coexist harmoniously. The brief explored how design can promote a sustainable future through technological innovation, cultural stewardship, and human-centred solutions. Applying concepts from Speculative Design and Design for Sustainability (DfS), students imagined a future where technology and humanity work together for an equitable, inclusive, and regenerative world. The project was undertaken at a postgraduate level in the Industrial Design Department at a South African higher education institution. Ten students undertook the project in five teams of two. Teams were selected to represent diversity in gender and race to allow for diverse perspectives in each team.

The project was structured according to the four phases of the Double Diamond Model: Discover, Define, Develop, and Deliver. Lee et al. (2025) argued that "*for an efficient Human-AI collaboration in design, it is important to guard the territory of humans' works and define AI's role clearly*" (p. 12). According to Tang et al. (2024), by engaging in hands-on activities, students develop a personal connection to their work, establishing creative ownership and originality. Therefore, they recommended that educators structure design curricula and projects that delineate the convergent and divergent design phases and the role of AI in these phases (Tang et al., 2024). Based on the contextual literature presented above, when analysing the design process and its phases, I believe the first diamond of the Double Diamond Model is critical, as this is where the problem and design intent are defined.

As the project brief was incredibly nuanced, addressing issues of sustainability and cultural heritage, and to mitigate the potential of "shallow" or biased responses driven by algorithmically biased AI data (Lee et al., 2025; Michel-Villarreal et al., 2023; Zhai et al., 2004), the decision was made to split the project into two distinct phases or "diamonds". "Diamond 1", or the first half of the project, was conducted using traditional processes, drawing on tacit design knowledge, theoretical application, and practical skills. Using the UN SDGs as their foundation, each pair selected one of the 17 goals as their broad topic of focus. Teams then explored and investigated their chosen SDG, delving into specific challenges or themes within it. This involved asking critical and speculative questions, such as "What if…?" and "How might we…?" This exercise was not about solving problems but rather about using design as a tool for critical questioning, reimagining, and proposing alternative futures. In-class ideation and matrixing activities were undertaken to encourage active participation and iterative, divergent thinking (Hasanein & Sobaih, 2023). Students had the opportunity to use AI to generate visuals of the in-class activities (Figures 2 and 3) as a means of practising and becoming familiar with the AI tools.

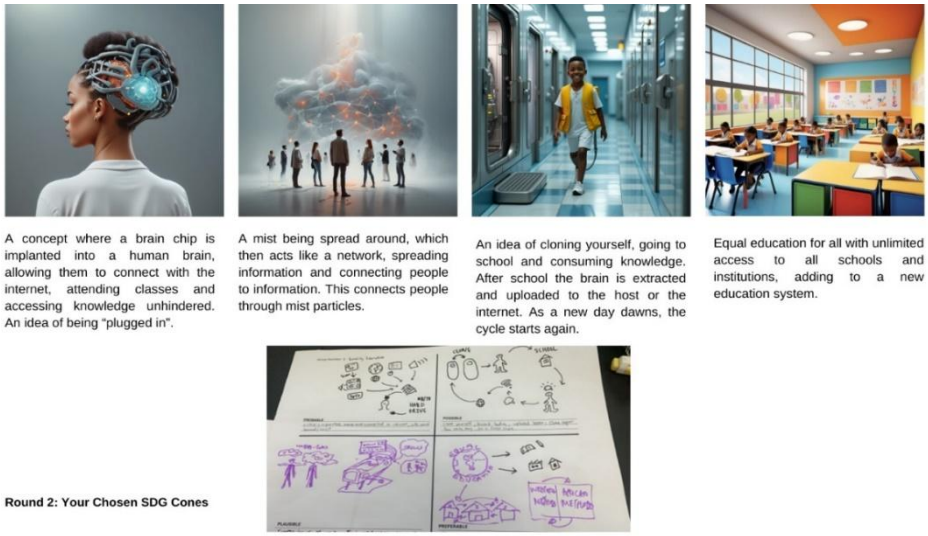

Figure 2: AI prompts and visualisations of in-class matrix activity (2025)

Figure 3: AI-generated visualisations of in-class ideation activity (2025)

The primary goal of the first phase was to clearly define a problem and establish a clear design intent or speculation, embodied in crafted AI prompts. In the second half

of the project, or "Diamond 2", students were required to engage with generative AI tools of their choosing to visualise their concepts. Due to the fast-paced nature of this three-week project, AI was incorporated into the visualisation phase of the project to enhance students' ability to effectively communicate complex ideas and improve time efficiency. This approach reduced limitations with students' CAD skills and technical execution, thereby unlocking greater imaginative potential. A key aspect to note is that the prompts developed in the first phase had to be specific, clearly detailing the intended solution, rather than asking AI to conceptualise ideas or solutions independently. The role of AI was strictly to generate visuals based on the students' detailed instructions.

Tang et al. (2024) and Mayers (2024) highlighted the importance of encouraging critical assessment of AI outputs so students can develop a critical eye and discern the quality and relevance of the AI-generated outputs. Therefore, students were required to document their AI use in the form of a storyboard, recording each iteration, including the prompt used, the generated outcome, an assessment of that outcome, and how they modified the prompt to improve the results (Figure 4). Students were also asked to submit unstructured 300-word written reflections upon completing the project, followed by a semi-structured online questionnaire to provide additional feedback, three months after the completion of the project. The data collected captured insights into students' experiences, perceptions, and the impact of AI tools on their design processes.

Figure 4: Snapshot of AI storyboard documentation (2025)

5. Findings

This section presents the findings from the "Observe" phase, drawing on data from the written reflections and the subsequent online questionnaire. To ensure research ethics, the details of all student participants have been kept anonymous. Each group submitted written reflections, which are cited using group numbers (1, 2, 3, 4, and 5). Individual reflections from group members are coded as A or B. Of the 10 students, 8 completed the online questionnaire, and their individual responses are coded as P1 through P8. The findings are presented as follows: first, the key themes identified

through the thematic analysis of the written reflections are discussed, followed by an overview of the questionnaire responses.

As a pilot study, the research was conducted with a single class of 10 students and therefore reflects a relatively small and context-specific sample. While this limits the generalisability of the findings, the study is intended as an exploratory first cycle within an ongoing AR process. The insights generated are thus not positioned as definitive, but as contextually grounded contributions that inform subsequent cycles of iteration, refinement, and broader investigation. In this way, the findings hold value in shaping future research directions and deepening understanding of AI integration in design education.

Written Reflection Findings

Across the five groups, thematic analysis of the initial written reflections on AI use in the design process revealed three recurring themes, unpacked below.

Divergent vs convergent

Consistent with Fang (2023), students overall found AI to be a useful tool during the divergent phase of the design process but far less effective during the convergent phase. AI helped provide initial inspiration by quickly visualising concepts and offering many directions to explore (1A; 2A). However, all groups (1A; 2A; 3A; 4A; 5A) consistently noted that AI image tools struggled to make subtle, incremental adjustments. Instead of refining existing visuals, AI often regenerated entirely new images, leading to inconsistent quality and undermining the convergence and fine-tuning stages. Additionally, AI frequently failed to accurately capture students' intended outcomes (2A; 4A; 5A; 5B), requiring them to "keep adjusting" their prompts (4A; 2A) to achieve the desired result. Many students described this process as "*frustrating*" (2A; 3A) and "*annoying*" (4A).

Technical glitches

From a technical standpoint, many groups faced issues with the inability of AI to accurately depict human anatomy and text. Students reported that AI "*struggled to generate accurate hand and facial details*" (1A), often producing figures with "*unusual proportions, extra fingers, awkward poses, multiple limbs, and disfigurements*" (4A; 4B). One group also noted that AI sometimes generated images containing text, but the resulting "words" were jumbled mixtures of letters from different languages (4B).

Bias

A key finding noted by all groups was the underlying biases and prejudices in AI-generated outputs. As an incredibly nuanced project with a core focus on cultural heritage and contextual factors, it is unsurprising that many of the students identified racial and cultural biases in their outputs. Many groups noted that without the words "African" or "black" in the prompts, the generated outputs predominantly depicted white males (1A; 5A; 2A; 3A). When the term "indigenous" was used, the AI tool would often output characteristics of Native Americans, unless "African" was added (4A; 4B). One participant remarked: "*Even with reference images, AI struggled to capture*

the intricate details and cultural authenticity" (5B). AI showed difficulty generating traditional South African attire, as the AI only produced something that "looked" African but did not belong to any specific tribe's real attire (5A). A black student noted a significant discomfort caused by the AI-generated images, stating: "*I didn't enjoy using AI in this project. […] I found the imagery unsettling; it was uncanny and made me physically uncomfortable*" (3B). Finally, a particularly interesting observation was that:

> "*AI was great at creating architecture and whole environments, especially where futurism was a prompt; however, it struggled profusely with prompts including 'Afro-futurism' or 'African', as often this resulted in all removal of 'futuristic' elements to be replaced by natural tones and desolate areas.*" (2B)

Additional findings

Ultimately, there was a variation in takeaways and reflections among the individual students. Some were reflective of their personal opinions and beliefs, with two students specifically highlighting their hesitancy or aversions to using AI based on personal belief systems.

> "*As I am generally very anti-AI, I would not have explored AI-image-generating tools in aiding the design process on my own and found the process to be fun but at times a hindrance to my imagination and time management.*" (3A)

> "*I am personally not a fan of AI due to the copyright infringements and discredit it does to artists and designers.*" (4B)

Some students acknowledged that while AI holds significant potential as a powerful tool (4A; 4B; 5B), overreliance on it is unwise. They emphasised that it is "*better to use it critically and sparingly than to rely entirely on it*" (4A) and that "*it shouldn't be depended on*" (4B), with another highlighting that "*human intuition and cultural understanding remain irreplaceable*" (5B). These reflections demonstrate thoughtful engagement and a critical awareness of both the promise and the limitations of AI in the design process.

Questionnaire Findings

The online questionnaire included four questions (Figure 5). This section presents an overview of responses to each of the questions.

Online Questionnaire Questions:

1. "Referencing the specific AI tools/software used, please reflect on the use of AI in your visualisation phase. Please include specific examples of pros and cons/challenges and exciting aspects".
2. "Based on your experience using AI in the design process, at what stage(s) of the design process do you believe, AI generative tools are most useful or impactful, and why?
3. "Similarly, which phases/stages of the design process do you feel, do not benefit from AI, and why?"
4. "Would you want to use AI in your design process again?"

Figure 5: Online questionnaire questions (2025)

The AI tools most used included: Adobe Firefly (paid for by the university and available to all students), ChatGPT (free), and Canva Pro. Others included Leonardo AI (the free version with limited tokens), NightCafe, and Nuelink (free). The students

noted that paywalls resulted in them using free/limited AI tools (P3; 5B); however, those who used both free and paid-for AI tools noted that, "*in the end, the results were quite similar*" (P4). Adobe Firefly, the paid-for tool, was seen as most useful, as it was easy to use (P3) and able to achieve complex, detailed images accurate to the prompts and reference images, allowing one to generate multiple images at once (P3). However, one student noted that it "*struggled to create humans*" (P2). Canva was referred to as "*juvenile*" (P3) in comparison to Adobe Firefly, and ChatGPT was limiting, as it could only produce one image at a time (P2). Students preferred using tools that allowed for image uploads over prompt-only tools, as this created more control and stronger outputs (P7). It was again noted that the limitation of various AI tools lacked cultural knowledge, showing "*surface-level interpretation*" (P3) of cultural influences (P5). "*One of the biggest challenges we faced was when the AI made any prompt using words like 'Afrocentric' or 'afrofuturistic' immediately had rural villages and sand*", explained one participant (P4). Another student went so far as to say: "*The AI software was very obviously biased towards white people, and the images generated when using the words 'African' or 'black' were quite horrifying and racist*" (P6). However, Nuelink was reported to understand prompts well and "*automatically had diversity in the 'human' imagery it generated*" (P8).

When asked, "At what stage(s) of the design process do you believe, AI generative tools are most useful or impactful, and why?", there were mixed responses across the group, as shown in Figure 6. Three students (P1; P4; P8) felt that AI would be most useful in the research/inspiration phases. Another three students (P2; P3; P5) felt it would be best used for rendering CAD models and final output in the final stages of the process for presentation. Two students (P3; P7) saw value in the ideation/conceptualisation phase, before the convergent refinement phase. One student (P6) said they would not use AI due to ethical concerns, stating: "*AI is stripping people from their imagination and robs them of their desire to actually learn and grow skills*" (P6). While responses varied, all students agreed that the first convergent phase, defining design direction and/or intent, should be driven by human intuition.

In response to the question, "Which phases/stages of the design process do you feel, do not benefit from AI, and why?" (Figure 7), three students (P3; P4; P7) argued that AI should not be used in the convergent phase to refine, create, or generate the final product or concept, stating that designers "*should still be accountable for the end product*" (P4). Two students (P2; P5) felt that AI should not be used in the divergent ideation phase, because it "*does not give new or relevant ideas*" (P2). P1 said that AI should not be used during research, specifically, problem identification and empathising with users, as "*rapidly generating research using AI could make designers lazy during this phase and lead them to not fully understand the problem*" (P1). Both P6 and P8 did not support the use of AI, stating:

> "*In using AI generative tools, we fall into the fallacy of progress – we will still be working just as much if not more, but less so with our creativity, which is one of our innate human capabilities.*" (P6)

> "*I am personally not a fan of AI due to the copyright infringements and discredit it does to artists and designers.*" (P8)

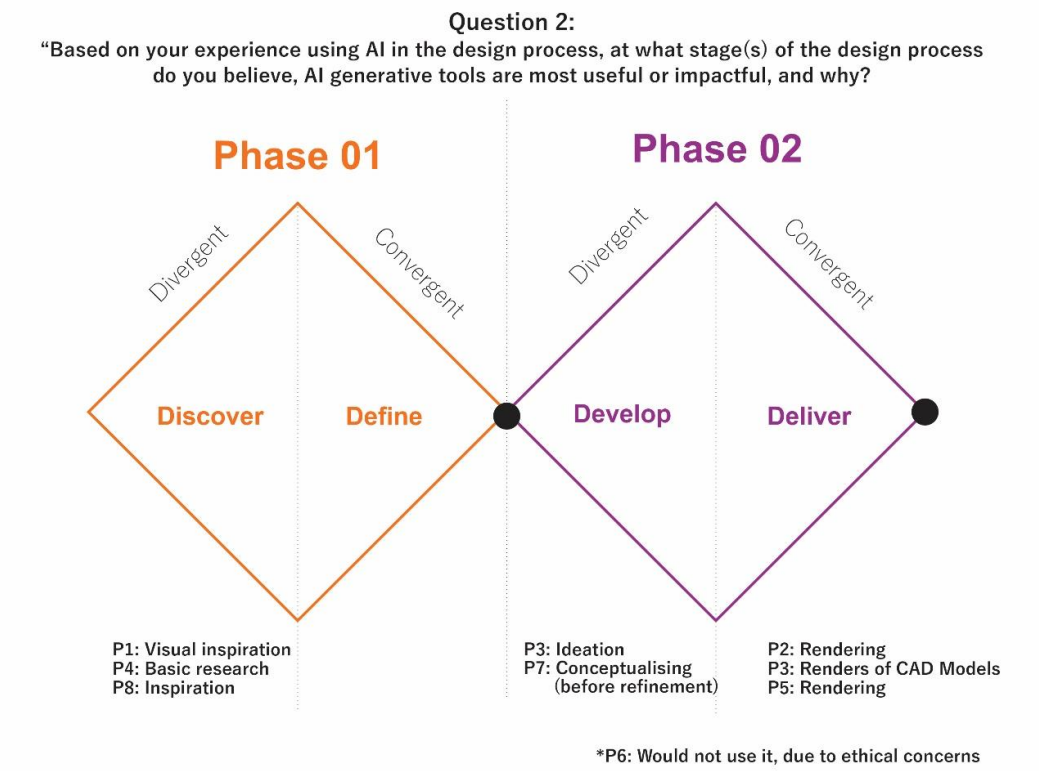

Figure 6: Question 2 responses plotted on the Double Diamond Model (2025)

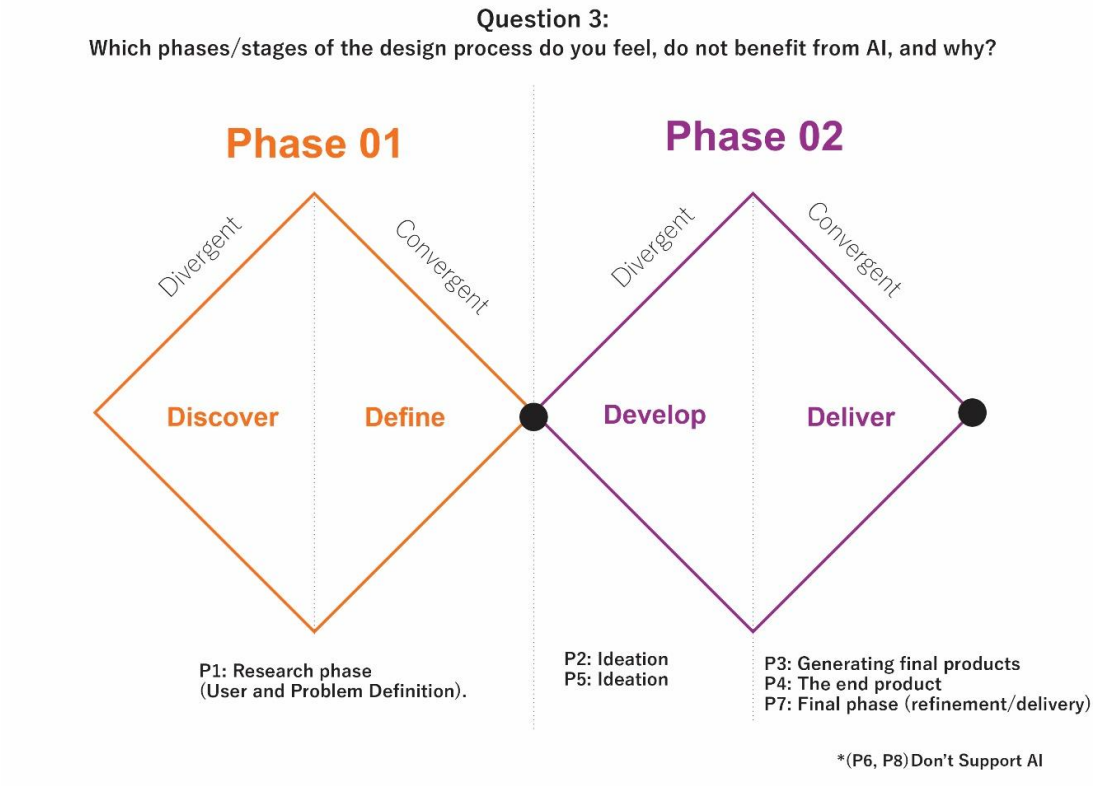

Figure 7: Question 3 responses plotted on the Double Diamond Model (2025)

Finally, when asked, "Would you want to use AI in your design process again?", five of the eight respondents said yes, two said no, and one was unsure (Figure 8).

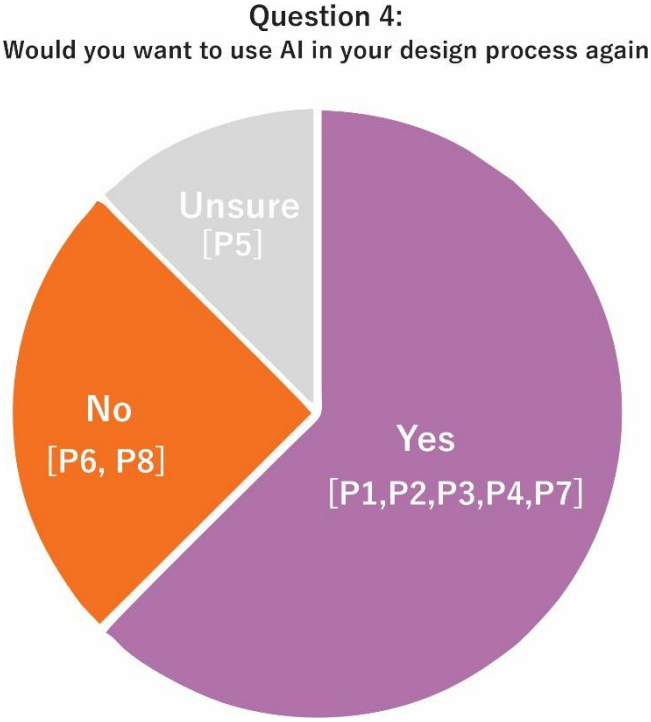

Figure 8: Question 4 responses (2025)

6. Discussion and Recommendations

As both the researcher and project facilitator, I analysed the findings presented above and reflected on my observations of the project process (use of AI) and outcomes. Based on this reflection, this section presents a discussion of the findings and offers recommendations for further study (Objective D).

When in the Process to use AI

As seen in the literature review presented above, the findings of this study reveal diverse perspectives on when and how AI should be integrated into the design process. While some students found AI more valuable during the divergent phase and others during the convergent phase, all students agreed that the define phase of Diamond 1 should remain entirely designer-driven. This highlights the importance of human cognition, critical thinking, creativity, and contextual understanding in design projects. At this stage, AI appears most useful for rapid ideation and visualisation, while the convergent definition and refinement phases still require human input and guidance to achieve the desired outcome. Although AI cannot yet generate a final product, designers can leverage image inputs and CAD models to create higher-quality renderings and presentation materials in later stages.

AI Tool Accessibility and Prompt Engineering

The project brief did not specify which AI tools to use, and students were not explicitly taught how to prompt the AI tools. These were intentional decisions aimed at assessing two key aspects. First, I wanted to determine which AI tools students were drawn to or aware of and encourage them to explore a variety of different tools during their process. This approach also allowed for the use of free AI packages, which, as noted in the reflections, may have been a limiting factor for some students. Many

noted the need for further improvements in the AI functionality. Paywalls and inaccessible tools due to cost barriers resulted in ineffective AI use. Second, I aimed to observe the level of students' awareness and understanding of AI prompting and how this would improve or develop throughout the project. However, through the analysis of the AI storyboard documentation and project outcomes, it appears that the lack of guidance on prompt engineering was a limiting factor in the overall success of the outcomes. Those teams with short, non-specific prompts (Figure 9) generated far more generic and superficial outcomes, needing significantly more iterations and prompt refinement. Those with longer, more detailed prompts (Figure 10) were able to generate outcomes more closely in line with their design intent.

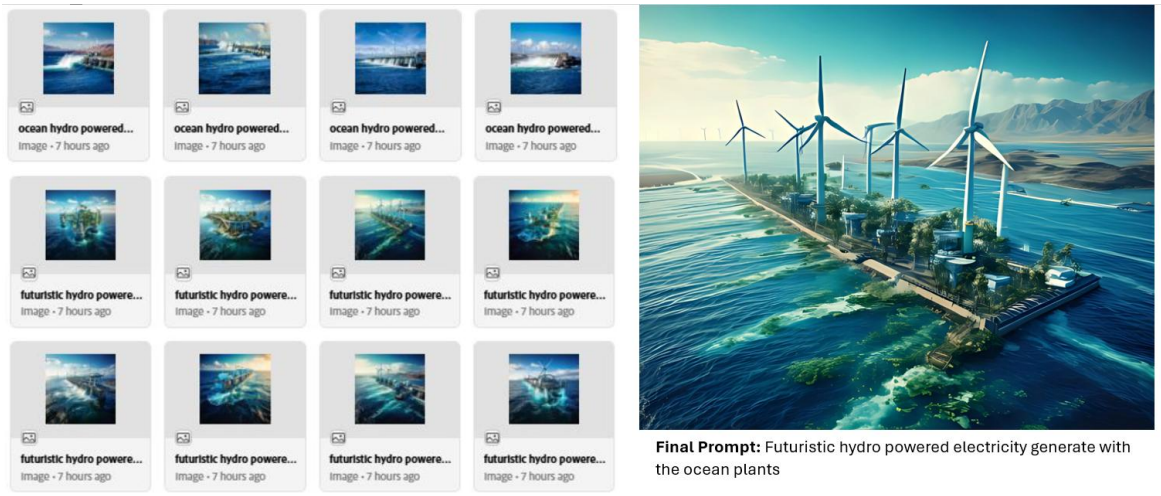

Figure 9: Snapshot of Group 2's AI-prompting process (2025)

Figure 10: Snapshot of Group 5's AI-prompting process (2025)

Students' Engagement and Critical Consciousness

A key observation was that students demonstrated both awareness of and engagement with AI, acknowledging its potential benefits. However, there was a clear

sense of scepticism and caution about the role AI should play in the design process and its implications for designers and product outcomes. This deeper level of critical reflection may be attributed to the fact that the participants were postgraduate students with advanced practical skills and a more developed understanding of the design process, design thinking, and design ethics. In contrast, students in earlier year groups may lack this level of maturity and skills and be more susceptible to the misuse of, or overreliance on, AI tools without the necessary reflective and critical skills, thereby negatively affecting their learning. Alternatively, the use of free, less powerful, and more restricted AI tools, as discussed above, may have negatively influenced students' perceptions of AI, particularly its capabilities and effectiveness in the design process.

Recommendations for Next Cycle

Due to the limited scope of this pilot study, it is not possible to develop comprehensive recommendations for the effective and ethical integration of AI in design education. However, based on the analysis of student reflections and lecturer observations, the following recommendations are proposed for future research cycles to further extend and strengthen these findings:

- First, it is suggested that similar projects be conducted with undergraduate students across different modules to compare levels of critical consciousness, reflection, and potential overreliance at various stages of the learning process. This may help to determine the most appropriate point at which AI should be integrated into the curriculum.
- Second, students should be provided with a more comprehensive workshop on prompt engineering.
- Third, it would be beneficial to provide students with access to more advanced, paid AI tools, such as Midjourney, to enable greater control over the generation and iteration process.
- Lastly, a second iteration of the same project is recommended, this time allowing students access to AI during the first diamond phase, so that the depth and contextual relevance of the resulting outcomes can be more effectively compared.

7. Conclusion

This paper explored the role of AI in the design process, with particular attention to its application across divergent and convergent phases. The findings suggest that while AI is widely perceived by students as a valuable tool for supporting ideation and expanding possibilities during the divergent phase, its effectiveness diminishes during more focused, decision-driven stages of the process. The study highlights several factors that may influence students' perceptions of AI, including their level of design experience and the limitations of the tools available to them. The lack of prompt engineering training and the use of free, less powerful AI platforms may have constrained outcomes and contributed to a more critical view of the capabilities of AI, thereby raising important considerations around access and the impact of paywalled technologies in educational contexts. Furthermore, the level of critical reflection suggests that more advanced students may be better equipped to engage with AI in a thoughtful and discerning manner, whereas less experienced students may be more

susceptible to overreliance. Given the limited scope of this pilot study, these findings should be interpreted as exploratory rather than definitive. However, they provide a valuable foundation for future research, particularly in relation to how AI can be more effectively and ethically integrated into design education. Further investigation across different student levels, along with targeted interventions such as prompt engineering training and access to more advanced tools, may offer deeper insights into how AI can support both creative development and critical engagement. Ultimately, the study underscores the importance of positioning AI not as a replacement for human thinking but as a complementary tool that, when used critically, can enhance the design learning experience.

8. References

Bauer, E., Greiff, S., Graesser, A. C., Scheiter, K., & Michael, S. (2025). Looking beyond the hype: Understanding the effects of AI on learning. *Educational Psychology Review*, *37*, Article 45. https://doi.org/10.1007/s10648-025-10020-8

Chulvi, V. (2025). Effectiveness of the AI using different typologies of design methods. *Research in Engineering Design*, *36*, Article 7. https://doi.org/10.1007/s00163-025-00449-x

Clark, J., Porath, S., Thiele, J., & Jobe, M. (2020). *Action research.* NPP eBooks.

Fang, Y.-M. (2023). The role of generative AI in industrial design: Enhancing the design process and education [Conference session]. *International Conference on Innovation, Communication and Engineering*, Bangkok. https://doi.org/10.1049/icp.2024.0303

Hasanein, A. M., & Sobaih, A. E. (2023). Drivers and consequences of ChatGPT use in higher education: Key stakeholder perspectives. *European Journal of Investigation in Health, Psychology and Education*, *13*(11), 2599–2614. https://www.mdpi.com/2254-9625/13/11/181

Hashem, O. A., & Hakeem, M. B. (2024). Design education methodology using AI. *Journal of Art, Design and Music*, *3*(1), Article 11. https://doi.org/10.55554/2785-9649.1030

Krippendorff, K. (2006). *The semantic turn: A new foundation for design.* CRC Press/Taylor & Francis.

Lee, S.-Y., Law, M., & Hoffman, G. (2025). When and how to use AI in the design process? Implications for human–AI design collaboration. *International Journal of Human–Computer Interaction*, *41*(2), 1569–1584. https://doi.org/10.1080/10447318.2024.2353451

Mayers, J. (2024). *Innovating industrial design pedagogy: The role of generative AI in enhancing creativity*. https://doi.org/10.13140/RG.2.2.23537.70243

Michel-Villarreal, R., Vilalta-Perdomo, E., Salinas-Navarro, D. E., Thierry-Aguilera, R., & Gerardou, F. S. (2023). Challenges and opportunities of generative AI for higher education as explained by ChatGPT. *Education Sciences, 13*(9), Article 856. https://www.mdpi.com/2227-7102/13/9/856

Mokgatla, O., & Moseley, A. M. (2023). Speculative futures: Questioning nanotechnology and sustainable development through industrial design pedagogy [Conference session]. *17th DEFSA Conference Proceedings* (pp. 271–282). DEFSA. https://www.defsa.org.za/papers/speculative-futures

Moseley, A. M., & Bediako, K. (2021). Critical design futures: Challenging the gender data gap through pedagogy [Conference session]. *DE+AFRIKA+4IR+DEFSA 16th Conference Proceedings,* (pp. 114–125). DEFSA. https://www.researchgate.net/publication/358286107

Moseley, A., & Campbell, A. (2019). 'The pretty stuff': Gender bias and the future of design knowledge in the South African industrial design context [Conference session]. *Designed Futures: 8th International DEFSA Conference 2019*, Cape Town (pp. 184–195). DEFSA. https://www.researchgate.net/publication/337917914

Popenici, S., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. R*esearch and Practice in Technology Enhanced Learning*, *12*, Article 22. https://doi.org/10.1186/s41039-017-0062-8

Sagor, R., & Williams, C. (2016). *The action research guidebook: A process for pursuing equity and excellence in education.* Corwin Press.

Tang, X., Windham, J., & Benjamin, B. (2024). Pre-AI and post-AI design: Balancing human creativity and AI tools in the industrial design process [Conference session]. *International Conference on Artificial Intelligence and Future Education* (pp. 100–108). Association for Computing Machinery. https://dl.acm.org/doi/10.1145/3708394.3708413

Villalba, M., & Palomar, M. (2024). A review of AI application trends in industrial design. *Procedia Computer Science, 263*, 60–67. https://doi.org/10.1016/j.procs.2025.07.008

World Design Organisation. (2025). *Definition of industrial design*. https://wdo.org/about/definition/

Zhai, C., Wibowo, S., & Li, L. D. (2004). The effects of over-reliance on AI dialogue systems on students' cognitive abilities: A systematic review. *Smart Learning Environments*, *11,* Article 28. https://doi.org/10.1186/s40561-024-00316-7