

INTEGRATING ARTIFICIAL INTELLIGENCE IN STRATEGIC DESIGN EDUCATION: EMPIRICAL EVIDENCE FROM DESIGN COURSES

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Abstract

The rapid adoption of AI tools is transforming educational practices, particularly in Strategic Design, which demand complex problem framing and strategic decision-making. This study examines AI's impact on Strategic Design education through a course experiment where students developed strategic directions for real companies via established process phases. A post-course survey (N=50) assessed AI usage and perceived utility across phases, combining quantitative (Likert-scale) and qualitative measures. Results reveal AI's highest utility in early analytical phases (company description, market/competitor analysis, trend exploration, target identification), where it accelerates information retrieval and synthesis as a cognitive amplifier, without supplanting interpretive roles. Utility declines in generative phases (opportunity definition, scenario construction, selection), where human judgment, critical thinking, and strategic framing remain essential. Findings advocate explicit AI literacy, critical evaluation, and metacognitive training in design curricula, repositioning AI as an augmentative resource contingent on students' problem-framing and output-assessment skills. This approach cultivates designers balancing human reasoning with AI support in complex strategic processes.

Keywords: *Artificial Intelligence, strategic design, critical thinking, human–AI collaboration, design education.*

1. Introduction and theoretical background

Today's rapidly evolving society imposes unprecedented uncertainty and complexity on students preparing to enter the professional world. The modern workplace demands responses to ambiguous, multidimensional challenges that exceed the scope of individual expertise or monodisciplinary approaches, requiring instead holistic solutions developed through cross-disciplinary teamwork (Carella & Melazzini, 2023; Brassler & Dettmers, 2017; Yusri et al., 2024). Higher education must therefore prioritize cultivating core 21st-century competencies such as critical thinking and problem-solving, effective communication, collaborative capacity, team leadership, and creative innovation, essential for tackling contemporary challenges with both analytical rigor and imaginative insight (Brassler & Dettmers, 2017; Stentoft, 2017; Yusri et al., 2024).

The teaching of Strategic Design in higher education serves as a critical mechanism for equipping students with competencies essential for professional success. This discipline employs design-centered methodologies to formulate corporate strategies, systematically integrating product, service, and communication dimensions to construct organizational identity, competitive positioning, and mission clarity (Bell, 2008). Professionally, Strategic Design generates distinctive strategic outcomes through its inherently multidisciplinary character, functioning as a vital conduit between management practice and creative disciplines (Barrett & Sexton, 2006). Design's core methods such as rapid prototyping, visual canvases, narrative scenarios and iterative sensemaking empower strategic designers to decode ambiguous, open-ended challenges, identify emergent societal patterns beyond organizational boundaries, and catalyze decisions with enduring impact (Zurlo, 2009; Calabretta et al., 2016). Learning Strategic Design is therefore essential for young designers, as it provides them with a human-centred and future-oriented mindset and enables them to act as a bridge between business and design within organisations, bringing to light opportunities to improve the company's offering.

When discussing education and how it must change to cope with the growing complexity of today's society, it is essential to consider the new role that technologies such as artificial intelligence (AI) are coming to play. AI's pervasive influence is reshaping societal structures across domains, boosting efficiency and intensifying ethical and equity challenges (Sabherwal & Grover, 2024). In healthcare,

governance, and creative sectors, AI automates cognitive labor, enhances predictive capabilities, and reconfigures employment landscapes, potentially displacing roles while exacerbating digital divides (Cai & Huang, 2025). Concurrently, risks of bias, diminished human agency, and socioeconomic polarization demand robust governance frameworks. This social transformation requires education systems to adapt, rethinking how technology influences teaching, learning and skills development.

Educational frameworks must therefore account for technology's transformative influence on pedagogy and learning processes. The widespread adoption of AI tools is fundamentally reshaping instructional practices, particularly within disciplines requiring sophisticated problem framing and anticipatory decision-making, such as Strategic Design. In educational contexts, AI streamlines instructional design and facilitates adaptive learning experiences calibrated to individual learner profiles and cognitive needs (Ouyang & Jiao, 2021; Chen et al., 2020). While AI's democratization represents a landmark advancement in accessible computational intelligence, it simultaneously unveils complex opportunities and risks within educational settings. By powering systems that rival or exceed human capacities in pattern recognition, information synthesis, predictive modeling, and adaptive reasoning (Chen, Chen, & Lin, 2020), AI introduces profound dualities: it promises unprecedented personalization and efficiency gains, yet risks eroding pedagogical integrity through uncritical adoption, over-reliance, or inappropriate delegation of cognitive responsibilities by both instructors and learners (Chatzipanagiotou, 2025; Tshuma, 2025). Particularly within design education, this tension becomes acute, as AI's analytical strengths must be balanced against the interpretive and creative demands central to the discipline. Recent research confirms that generative tools are most effective when integrated as scaffolds for exploration, synthesis, and reflection, rather than as autonomous decision-making systems. Studies on human-AI collaboration emphasize that students benefit from AI when they are guided to evaluate outputs critically, check sources, and retain responsibility for strategic choices. Within this perspective, AI literacy is increasingly understood as a multidimensional competence that includes technical fluency, critical judgment, and ethical awareness (Schauer, Simbeck & Pinkwart, 2025; Valentine et al., 2026). Yet, despite these emerging insights, empirical evidence remains limited regarding AI's specific impact on design pedagogy, particularly within Strategic Design curricula.

This gap in the understanding of the potential impact of AI on improving or deteriorating the quality of education in the field of design has received insufficient attention from practitioners and educational policymakers. Therefore, the aim of this study is to investigate how AI influences the teaching and learning of Strategic Design within higher education.

2. Methodology

The course provides foundational knowledge, tools, and methodologies in Strategic Design, a discipline that has evolved over the past two decades to address increasing complexity and rapid change in society, markets, and technology. Teaching is grounded in the context of business organizations and integrates theoretical instruction with case studies, practical exercises, and applied design methods. The course aims to develop students' ability to understand and apply the strategic role of design across different organizational models, with a focus on product-service systems and innovation processes. By the end of the course, students are expected to have acquired a basic vocabulary of concepts, tools, and methods specific to these fields, as well as the cognitive flexibility needed to approach and solve systemic design problems. Assessment consists of an oral examination and a coursework assignment that requires students to interpret contemporary social, environmental, or market-related issues and propose strategic design interventions through a tailored proposal.

This study presents an analysis based on questionnaires distributed to students of the course, with the aim of gathering information on the potential use of AI and how it was employed in the development of the assignment's final deliverable. The survey collected 50 responses and employed a mixed-methods structure, combining open-ended questions with Likert scale items. Specifically, the questionnaire was divided into three sections: the first aimed to gather a general understanding of students' use of AI tools in design contexts; the second focused on measuring whether and to what extent they had used AI tools at each stage of the project and whether they had found them useful and/or influential; the third section explored the students' experience of using AI during the project: when it was perceived as useful and when not, its limitations and strengths, and whether they would use it again to carry out the same project from scratch. The responses were compiled into an Excel file and analysed using descriptive statistical methods and visual representations (Hays, 1973). The results were discussed and interpreted by a research group comprising two lecturers and three academic researchers.

3. Results and discussion

A comprehensive survey was administered to former students of the Strategic Design course. The questionnaire combined quantitative and qualitative items and was structured using a 5-point Likert scale, where 1 indicated strong disagreement and 5 strong agreements. In addition, multiple-choice and open-ended questions were included to validate, triangulate, and deepen the interpretation of the Likert-scale responses. The results suggest that AI is already a familiar and relatively consolidated resource in students' design workflows. Respondents reported frequent previous use of AI tools in design-related contexts and generally declared a fair level of confidence in using them. This indicates that AI is not perceived as an entirely external or exceptional technology, but rather as a tool that students have already begun to integrate into their everyday working practices.

A first relevant finding concerns the distribution of AI use across the strategic design process. AI appears to have the greatest impact in the early and analytical phases of the project, especially those involving research, data gathering, synthesis, and comparison. In particular, students associated AI with description of the selected company, product portfolio analysis, SWOT analysis, positioning map relative to competitors, identification of the target audience and analysis of emerging market trends. In these phases, AI was mainly used to accelerate the retrieval and organization of information, to summarize large volumes of material, and to support preliminary sense-making. By contrast, the perceived usefulness of AI decreases in the more interpretative and generative phases of the process, such as the identification of wants and desires, definition of the opportunity, identification of variables and polarities and development of future scenarios. Here, students consistently stressed the importance of human judgment, critical thinking, and contextual interpretation. These phases were perceived as less delegable to AI because they require the ability to make strategic choices, detect nuance, and transform ambiguous inputs into meaningful design directions. In other words, AI helps students read the problem, but humans still seem to be the ones who must frame it strategically. Table 1 shows the mean perceived usefulness of both AI and human contribution across the strategic design phases, with means based on students' responses to 5-point Likert-scale items, with higher scores indicating greater perceived usefulness of AI. While human input is consistently rated as highly necessary and irreplaceable, the use of AI emerges as a valuable support tool whose impact varies by project phase, with generally higher scores during analytical phases and notably lower scores during ideation and generative phases.

Table 1. Mean perceived usefulness of AI and human contribution across strategic design phases.

Strategic design phase	Mean AI usefulness	Mean human usefulness
Description of the selected company	3.62	4.43
Product portfolio analysis (BCG Matrix)	3.89	4.55
SWOT analysis	3.72	4.34
Positioning map relative to competitors	3.68	4.26
Identification of the target audience	4.34	4.17
Analysis of emerging market trends	2.94	4.83
Identification of wants and desires (WANTS/DW)	2.04	4.77
Definition of the opportunity (HMW)	2.19	4.77
Identification of variables and polarities	2.34	4.72
Development of future scenarios (Scenario Matrix)	1.83	4.53

Another important pattern emerging from the responses is that AI is rarely considered sufficient on its own. Even when its outputs were judged useful, students repeatedly emphasized the need for human intervention to verify, refine, and reinterpret them. This confirms that AI is valued mainly as a support system for cognitive and operational tasks, rather than as an autonomous design agent. Many responses also highlight a recurring issue of reliability, with students noting the need to check sources, correct inaccuracies, and filter generic or overly repetitive suggestions. The open-ended answers in the qualitative sections of the survey answers reinforce this interpretation. Students frequently praised AI for its ability to "speed up research", "identify connections worth exploring" and "synthesise large volumes of data". Many highlighted its value in expanding initial ideas through "alternative formulations" and "initial insights". However, limitations consistently emerged in stages requiring originality ("AI often produces the same answers, very limiting for creativity") or strategic depth ("Some choices are too important to be delegated

to artificial intelligence”). Numerous respondents emphasised that AI outputs required human review: “AI-generated results only became meaningful after human review” is consistent with comments such as “all tweaked by hand”, “source verification” and “critically reworking AI outputs”. As one student summarised: “AI provides the raw material; we provide the direction”.

Finally, 85% stated that they would reuse AI in similar projects, confirming that its perceived educational value lies in workflow efficiency, whilst preserving the interpretative core for human designers. However, this willingness was accompanied by a clear awareness of its limitations. AI was not imagined as a substitute for Strategic Design, but as a complementary tool that supports research, accelerates repetitive tasks, and offers initial directions to be critically assessed. This is particularly relevant for strategic design education, where students need to learn not only how to use AI, but also when to trust it, when to question it, and when human insight must remain central.

These findings reveal that AI has already achieved significant adoption within student design practices, positioning it as a familiar and actively utilized resource rather than an experimental novelty. Students consistently frame AI as a valuable supporting mechanism, most effective during the initial analytical phases of strategic design where it accelerates information gathering, synthesis, and preliminary pattern recognition. However, its utility diminishes sharply in subsequent interpretive and generative stages, where human judgment, contextual nuance, and strategic synthesis remain irreplaceable. This clear demarcation across process phases underscores a fundamental insight: while AI excels as cognitive infrastructure for structured analytical tasks, it cannot supplant the designerly capacities required for problem framing, opportunity articulation, scenario development, and final strategic adjudication. These findings call for at least a partial rethink of how Strategic Design is taught in the age of AI. As this technology is now an integral part of modern culture and society, rather than discouraging its use in favour of a completely ‘human-driven’ approach to design, AI should be regarded as a useful tool for boosting productivity and an enabling partner, whose value depends on students’ ability to define and critically evaluate outcomes and make informed decisions regarding its use.

The pedagogical implications are multiple. Design educators must develop structured modules that teach prompt generation as a strategic inquiry, transforming random interactions into a rigorous methodological practice. Source verification protocols become essential components of an updated curriculum, teaching students to cross-check AI-generated insights against authoritative materials. Practices of metareflection to document when and why the use of AI proved productive or counterproductive should become standard requirements for assigned tasks, developing students’ ability to self-regulate their use of technology within complex workflows. This expanded skills model would not only prepare graduates to use AI tools, but also to integrate them strategically into professional practice. Designers of the future will need to be able to navigate hybrid workflows with ease, harnessing AI’s unrivalled analytical speed during the discovery phases whilst retaining interpretative authority during the synthesis and evaluation phases. They must be able to readily recognize the optimal scope of contribution for each: AI for convergent efficiency, humans for divergent creativity and ethical discernment.

4. Conclusions

Ultimately, this study affirms Strategic Design education's enduring mission: cultivating professionals who can navigate irreducible complexity through human-centered foresight. The research reveals three primary insights regarding the integration of AI. First, AI functions effectively as cognitive infrastructure for structured analytical tasks but cannot supplant designerly reasoning required for strategic problem framing. Second, students intuitively recognize AI's zone of optimal contribution, consistently positioning it as a supporting mechanism rather than a Strategic Design substitute. Third, effective human-AI collaboration demands metacognitive calibration, the ability to discern when to engage technology and when to preserve interpretive primacy. AI therefore emerges not as design's replacement but its evolution, expanding analytical capacity while demanding ever-greater interpretive sophistication. The challenge and opportunity lie in educating designers who don't merely tolerate this symbiosis but master it, ensuring human agency remains the strategic intelligence guiding technological amplification toward socially valuable outcomes.

Several research directions merit future exploration. Longitudinal studies could track AI fluency evolution across complete design programs, revealing how critical evaluation skills develop over time. Comparative analyses between design disciplines might illuminate discipline-specific integration patterns and optimal pedagogical approaches. Experimental interventions testing structured AI literacy modules against traditional instruction would provide causal evidence of educational impact. Industry studies examining professional design teams' AI deployment strategies could validate academic approaches against workplace realities.

Strategic Design education must evolve to cultivate designers who master human-AI symbiosis, leveraging technology's analytical power while preserving human interpretive authority. This balanced framework equips design graduates to navigate increasingly complex professional landscapes where technological efficiency must serve human-centered strategic foresight and socially valuable outcomes.

References

- Bell, S. (2008). *International brand management of Chinese companies*. Springer.
- Barrett P., & Sexton, M. (2006). Innovation in Small, Project-Based Construction Firms. *British Journal of Management*, 17(4), 331–346.
- Brassler, M., & Dettmers, J. (2017). How to Enhance Interdisciplinary Competence—Interdisciplinary Problem-Based Learning versus Interdisciplinary Project-Based Learning. *Interdisciplinary Journal of Problem-Based Learning*, 11(2).
- Cai, T., & Huang, J. (2025). AI's dual impact: Transforming society and social sciences. *Chinese Journal of Sociology*, 11, 3-4. <https://doi.org/10.1177/2057150X251316601>
- Calabretta, G., Gemser, G., & Karpen, I. (2016). *Strategic Design - Eight Essential Practices Every Strategic Designer Must Master* (1st Ed.). BIS Publisher.
- Carella, G., & Melazzini, M. (2023). Teaching Design in a Fully Remote Environment: Challenges and Changes in the Pedagogical Approach During the Covid-19 Pandemic. *ICERI2023 Proceedings: 16th annual International Conference of Education, Research and Innovation* (pp. 3985-3990).
- Chatzipanagiotou, P. (2025). Artificial Intelligence and Educational Management: Threat or Challenge for School Leaders. *END2025 Proceedings: 13th Conference of Education and Developments* (pp 166-170).
- Chen, H., Xie, D., Zou, X., & Hwang, G. J. (2020). Application and theory gaps during the rise of artificial intelligence in education. *Computers in Education: Artificial Intelligence 1*, 100002.
- Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, 8, 75264-75278.
- Hays, W. L. (1973). *Statistics for the social sciences* (2nd Ed.). Holt, Rinehart and Winston.
- Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2, 2-6. Doi: 10.1016/j.caeai.2021.100020
- Patricio, R., Dias, J., Carella, G., & Gancho, S. (2024). Managing design innovation challenges in a digital environment. *International Journal of Design Creativity and Innovation*, 12(3), 139-162.
- Sabherwal, R., & Grover, V. (2024). The societal impacts of generative artificial intelligence: A balanced perspective. *Journal of the Association for Information Systems*, 25(1), 13–22.
- Schauer, S., Simbeck, K., & Pinkwart, N. (2025). AI Literacy and Attitudes Towards AI in Design Education: A Comparative Study of Communication and Architectural Design Students. *Proceedings of the 17th International Conference on Computer Supported Education (CSEDU 2025)- Volume 1*, (pp. 464-471).
- Tshuma, T. (2025). Artificial Intelligence, the ultimate opportunity or threat to the essence and integrity of education. *END2025 Proceedings: 13th Conference of Education and Developments* (pp. 450-454).
- Valentine, L., Liu, W., Zhang, L., Bofylatos, S., Christer, K., & Cruickshank, L. (2026). The new normal? AI in design practice, education, and research. *The Design Journal*, 29(2), 293–298.
- Yusri, R., Yusof, A. M., & Sharina, A. (2024). A systematic literature review of project-based learning: Research trends, methods, elements, and frameworks. *International Journal of Evaluation and Research in Education (IJERE)*, 13(5), 3345.
- Zurlo, F. (2012). *Le strategie del design. Disegnare il valore oltre il prodotto*. Il Libraccio.