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SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

DesignAI Edge x SuperSkillsStack: The Future of Innovation and Resilience

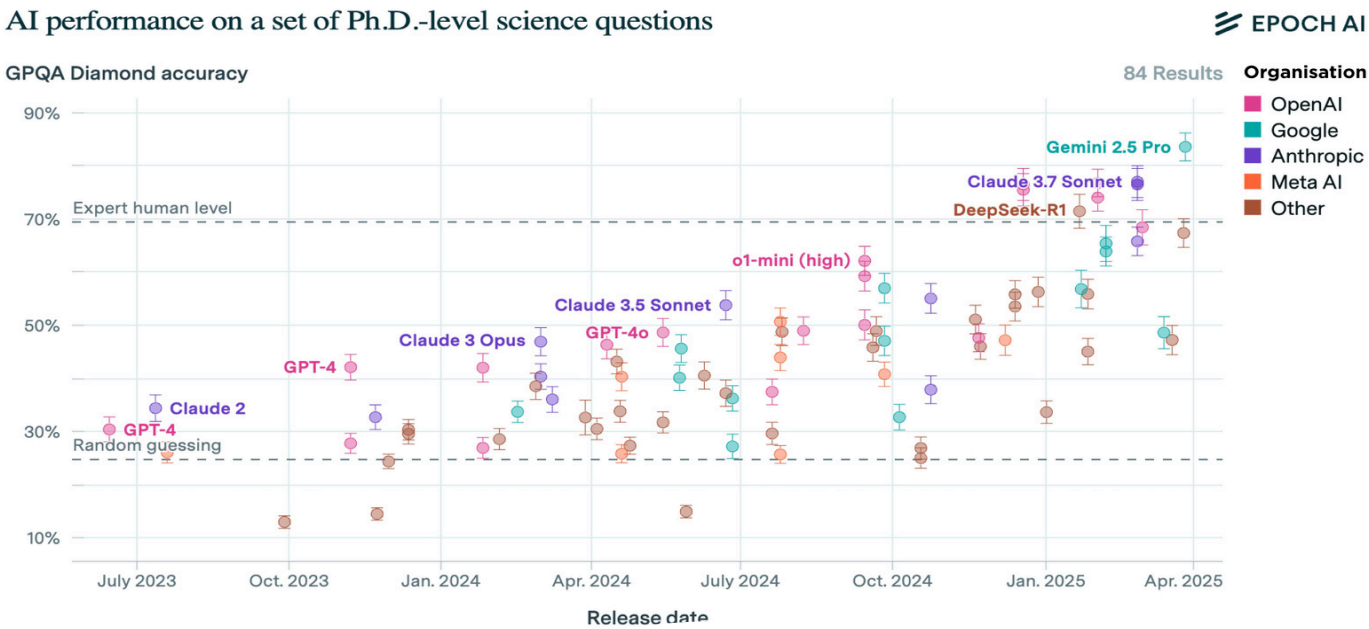
Insights from Future of Innovation Lab x
Lee Kuan Yew Centre for Innovative Cities

NEED:
AI breakthroughs are raising worries about disruption, dislocation, and deskilling. How can we stay resilient?

OPPORTUNITY:
Our X-Intelligence explainers offer insights grounded in what we and others are doing and researching. Each piece is short and laser-tight focused on a big topic. In this piece, we outline how designing and innovating with AI – what we call Design AI – nurtures innovators with an edge and next generation skills (i.e. SuperSkillsStack).

BIG TOPIC:

How might we strengthen resilience against disruption, dislocation, and deskilling? And also nurture innovators as AI advances accelerate in weeks and months instead of years?



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SUTD's house view is to give innovators the DesignAI Edge. Here is why and how.

AI disrupts all jobs, skills, and tasks. From a simple prompt, AI now generates instant answers.

Humans can lose their jobs as a result. Even if they do not, frequent use of such AI can cause cognitive deskilling (see References*).

Fears: Disruption / Dislocation and Cognitive Deskilling

Design AI can counter these fears and risks. Based on SUTD's first 15 years since its establishment, and the LKYCIC's decade-long research into the future of work and innovation (see References*), the DesignAI Edge does so in three ways:

**Reference list for Distributed Mastery, "Tool, Teammate, and Neither", and Deskilling (page 9)*

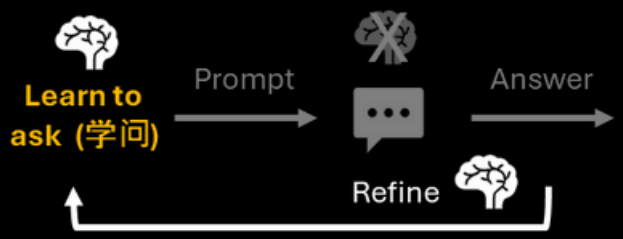
1. **Learn to Ask**
   Asking good questions
2. **Human-Centred Design**
   Crafting a deep care for human values
3. **Design Innovators**
   Making an impact on economy and society

01 Learn to Ask

Innovators with the DesignAI Edge learn to ask good questions. Asking good questions engages the mind. Instead of mindless prompting and generation, where nothing is learned, taking time to formulate a good question and refining it iteratively to arrive at high quality answers stretches the brain.

The risks of cognitive deskilling through mindless use of AI is thus reduced. The odds of cognitive strengthening through thoughtfulness are raised. (The Chinese word for "knowledge" is "学问" i.e. learn to ask, emphasising lifelong dedication to wisdom and self-improvement).

01. Learn to Ask



02 Human-Centred Design

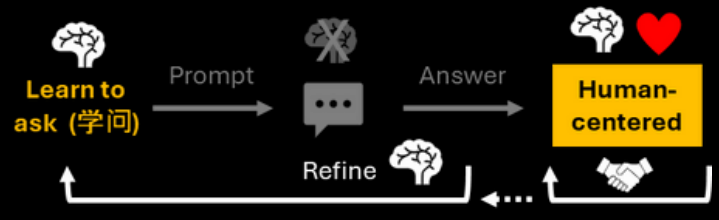
Innovators with the DesignAI Edge have a deep capacity for Human-Centred Design. This capacity is built from two interlocking human endeavours.

The first is that innovators must be human-centred. They interact with humans, and use their hearts and heads to empathise, understand, and translate human values into designs that humans value.

The Humanities, Arts, and Social Sciences are allies and assets in this. These disciplines help uncover the "sources of truth" for why humans live their lives the way they do, and when and how they change.

All these – interacting, empathising, understanding, having heart and head, and sensing change – must be lived. They cannot be AI-generated. They are what give such innovators an edge.

02. Human-Centred Design (head, heart, and hands x iteration x cohort-based pedagogy)



02 Human-Centred Design Continued

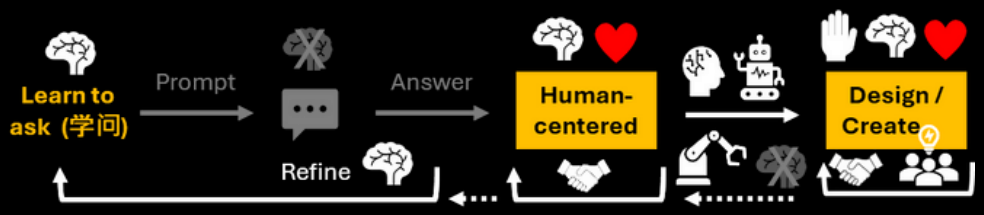
The second human endeavour is Design. Design is a human endeavour too because like the first, innovators must use both head and heart as they interact with users, ignite ideas with teammates, and iterate with both.

Moreover, through Design, innovators often make with their hands. Doing so is cognitive strengthening, because the "hand is the cutting edge of the mind" (Bronowski, 1973).

This is the case even when some of the AI are deskilling – any loss is more than offset by the depth and breadth of how innovators create, design, and make with a range of AI.

There is more. Recent research indicates integrating Gen AI into design thinking strengthens higher order learning outcomes through complex problem solving, critical thinking, and iterative innovation (see References*). Design is empowered by AI, instead of being disrupted by it.

02. Human-Centred Design (head, heart, and hands x iteration x cohort-based pedagogy)



03 Design Innovators

Innovators with the DesignAI Edge make an impact on economy and society. They make an impact by marshalling networks and resources to market, fundraise, and distribute locally, regionally, and globally.

Like in Human-Centred Design, they must similarly work with head and heart as they interact with users, ignite ideas with teammates, and iterate with both.

All these strengthen skills and resilience.

Moreover, when innovators make an impact on people's lives, they will always be relevant and in demand. That strengthens them further.

03. Design Innovators

The SuperSkillsStack

In addition to the DesignAI Edge, SUTD has also found from more recent research and practice involving AI, that we must empower innovators to craft their SuperSkillsStack.

The SuperSkillsStack spells out the higher-order skills that both sit on top and cuts across the core skills in the DesignAI Edge. There are five layers of skills:

1. Assemble ensemble of Humans ∞ AI
2. Agency
3. Domain knowledge
4. Imagination
5. Taste

Assemble ensemble of Humans∞AI

Innovators must be capable of assembling an ensemble of Humans teaming with AI. This is obvious from the visuals we built up for the DesignAI Edge – innovators have to work with many humans and AI, drawing on their collective expertise to achieve the impact they aspire.

This corroborates with the decade of future of work and innovation research in the Lee Kuan Yew Centre for Innovative Cities, where we found that mastery in the age of AI is in fact Distributed Mastery (see References*).

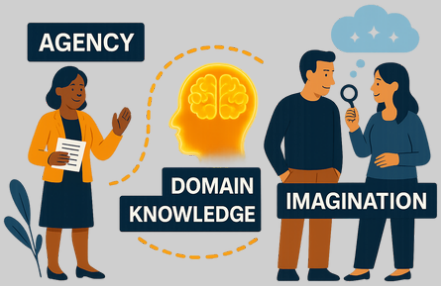
Agency x Domain Knowledge x Imagination

To assemble their ensemble, innovators must develop agency, domain knowledge, and imagination.

They need agency because they have to take the initiative to act, influence those around them, and shape the outcomes.

Domain knowledge increases the odds they have the expertise and mastery to know which combinations of humans and AI would meet the right performance, price, risk, and reward outcomes. They understand the problem enough to frame and ask good questions, and assess and judge answers (see section on Taste below).

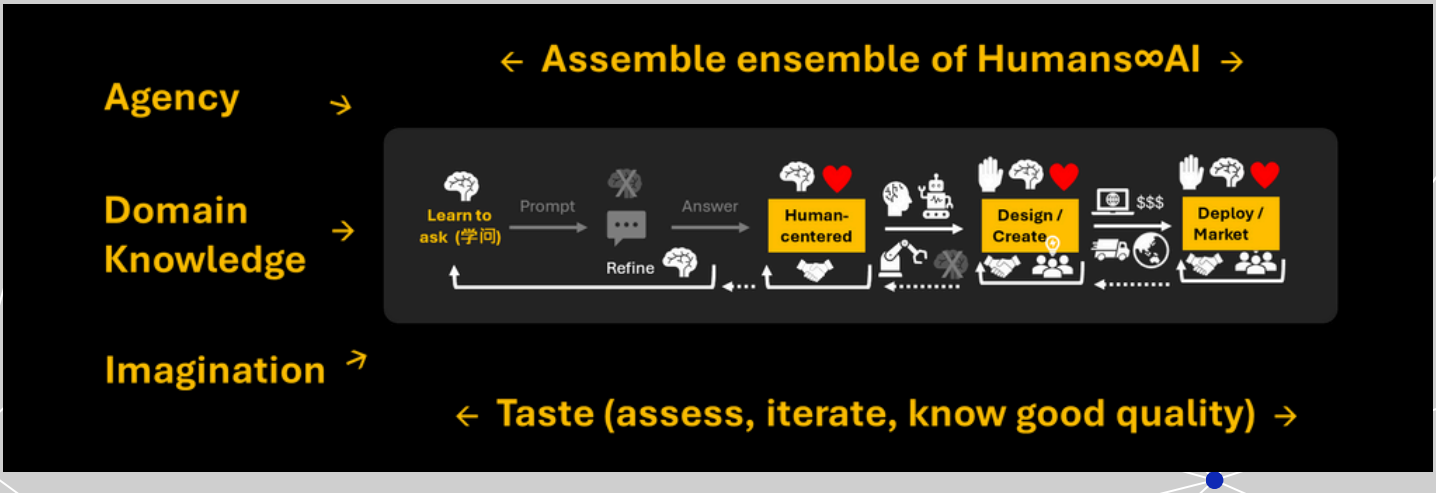
And imagination is crucial to ask different questions, see alternative options, and make new designs. Imagination also plays a part in assembling creative and unexpected ensembles.



Taste (assess, iterate, know good quality)

Innovators must nurture their taste. Taste is how they assess what is a good quality design, option, and outcome. They know how to refine their questions, evaluate iterations, and discern which human values matter and what humans value.

Taste acts in concert with its close cousin, domain knowledge (see above). Together, they recognise what “good” looks like, and whether to pivot or polish. They multiply the odds innovators design and create the highest performing ensembles of Humans ∞ AI.



In Action: The SuperSkillsStack

We illustrate the efficacy of the SuperSkillsStack with external and internal examples.

Example 1.

External: Terence Tao's Mathematical Project

In fall 2024, UCLA mathematician Terence Tao launched a project using AI to study algebra rules. He picked a system called a magma—sets with a rule for combining elements—and wrote thousands of statements about possible behaviors.

There were 22 million "if this, then that" cases. Over two months, more than 50 collaborators, using AI tools or hand proofs, checked almost all of them. By April 2025, they produced a massive map of rule connections, showing how AI and humans can team up on math (Cepelewicz, 2025).

This project is the SuperSkillsStack in action (see table below). The table also shows why the SuperSkillsStack is a stack.

It is because each layer amplifies the other. At the same time, any missing layer destabilises the stack as a possible point-of-failure.

For example, without Terence's agency to start, there would be no project. Without assembling an ensemble, there would be no collaborative problem solving. And without taste, it would have been hard to know which questions to pursue further.

Assemble ensemble of Humans ∞ AI	• Over 50 participants, including amateurs, some armed with AI and others just using their smarts, engaging collectively. • Expertise distributed across multiple experts and machines.
Agency x Domain knowledge x Imagination	• Terence Tao had the agency, domain knowledge, and imagination to start and manage the novel project and statements/questions. • The 50 participants also had the agency, domain knowledge, and imagination to choose to contribute.
Taste (assess, iterate, know good quality)	• Tested 22 million mathematical implications together. • Judged which mathematical questions to pursue further. • Experimented, iterated, and discovered collectively.

In Action: The SuperSkillsStack

We illustrate the efficacy of the SuperSkillsStack with external and internal examples.

Example 2.

Internal: Design Thinking and Innovation x AI

Design Thinking and Innovation is a Term 2 course for all SUTD Freshmore students that introduces design principles, processes, analytical methods, and social/cultural aspects. Students engage in team-based projects to design, create, and make solutions, guided by multidisciplinary instructors and a cohort-based pedagogy. This year, they were encouraged to go beyond working with AI as a "Tool", to AI as a "Tool, Teammate, and Neither".

Their experiences show the SuperSkillsStack in action (see table below).

Again the table illuminates why the SuperSkillsStack is a stack. Each layer works in tandem with the other. Any one layer less, and the students would have made less progress.

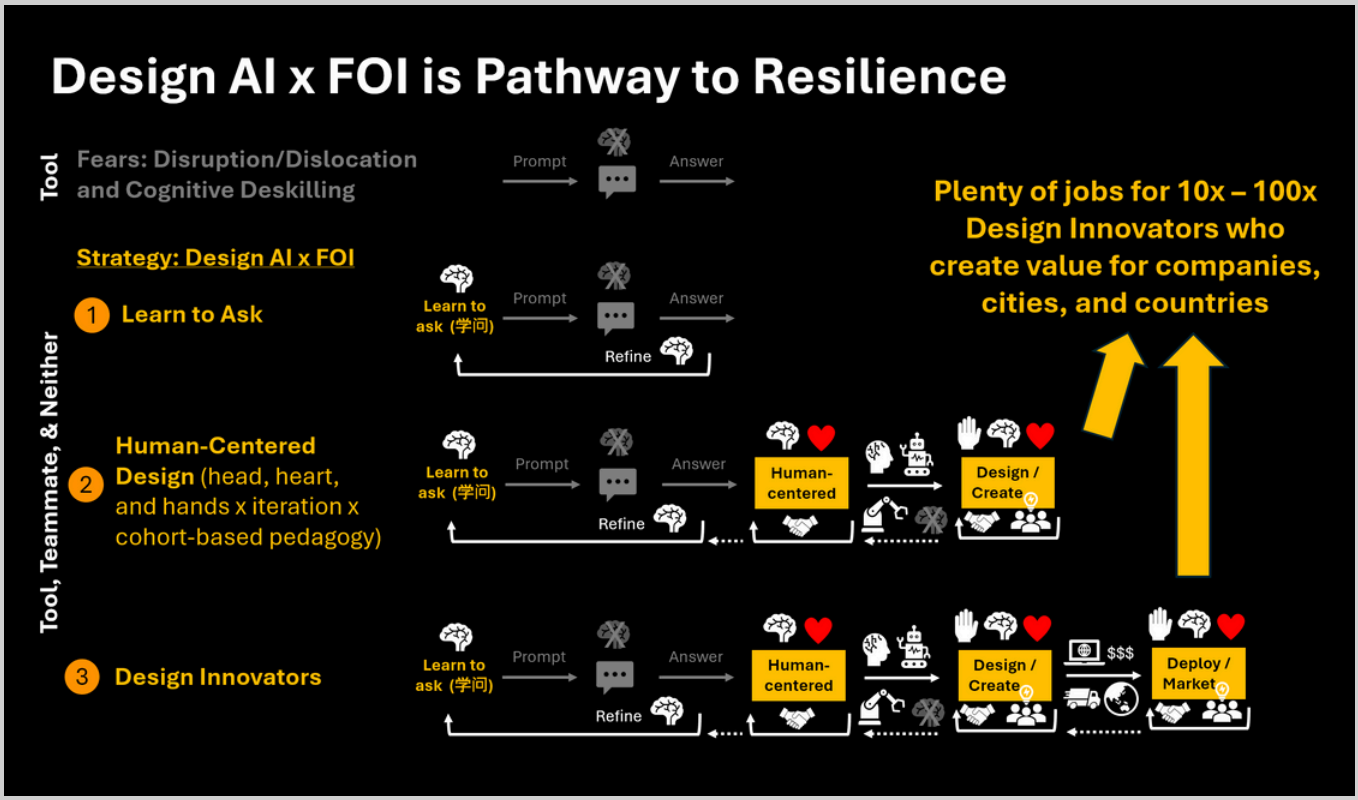
Assemble ensemble of Humans ∞ AI	• Assembled AI for rapid MVP testing, sentiment analysis and code generation, collapsing idea-to-prototype time from days to hours. • Turned a single sketch into multiple cross-domain visual concepts within hours (e.g., HyperSketch, GPT-4o). • Choosing the right AI helped novices do electronics builds, RFID systems, and Arduino troubleshooting, letting them reach working prototypes without prior hardware and coding backgrounds.
Agency x Domain knowledge x Imagination	• Teams had the agency and imagination to treat AI as a "sixth teammate," running the same prompt across Gemini, GPT-4, and DeepSeek then deciding which output—or human intuition—to trust (see Taste below too). • They thus also demonstrated their domain knowledge of different AI and human capabilities in the ensemble.
Taste (assess, iterate, know good quality)	• Students learned to spot hallucinations and judge when AI outputs felt "generic". • Chose not to use AI for real-user interviews in high-context or emotional scenarios.

The Future of Innovation and Resilience

SUTD's longstanding and growing research and practice insights into the DesignAI Edge, and the new emerging insights into the SuperSkillsStack point us towards three unprecedented possibilities in the future of innovation, work, education, and resilience.

This and future waves of AI compel us to move from thinking of AI as a "Tool" (used to perform a task and nothing more). We must now work with AI as a "Tool, Teammate, and Neither", where AI is also a partner, and in some cases, we choose not to use or work with it.

Persist in thinking of it as a "Tool", and we will be susceptible to the risks of dislocation, disruption, and deskilling. But when we begin to think of AI as a "Tool, Teammate, and Neither", we have more options for resilience (see preceding points and diagram below). We can become 10x to 100x more effective, becoming 10x to 100x innovators who are highly sought after.



The second exciting possibility is AI's ability to rapidly accelerate skill development. Over 50 participants solved complex math problems, and novices created advanced designs without prior training—imagine the impact when AI strengthens and accelerates that growth. We are moving from AI that compensates for weaknesses, to AI that transforms them into strengths (see also Kestin et al., 2024).

Lastly, SUTD has shown that we know how to build the DesignAI Edge and SuperSkillsStack. Imagine the opportunities that await if we also empower anyone and everyone beyond SUTD to do the same

More than having SUTD as the world's first Design AI university, Singapore will be the world's first Design AI nation. We will become a nation of innovators in the future of AI.

Co-written with an ensemble of Humans ∞ AI. Consistent with what we wrote, working with AI was fast and helpful especially initially (e.g. brainstorming flow), but firming up the final version was all human, taking much time, as well as iterating with domain expertise, agency, imagination, and taste.

REFERENCES

References for Distributed Mastery, "Tool, Teammate, and Neither", Deskilling, and Design x Gen AI Higher Order Learning

1. Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.

2. Balasubramanian, G., Lee, H., Poon, K. W., Lim, W. K., & Yong, W. K. (2017, July). Towards establishing design principles for balancing usability and maintaining cognitive abilities. In A. Marcus (Ed.), *Design, user experience, and usability: Theory, methodology, and management* (Lecture Notes in Computer Science, Vol. 10288, pp. 3–18). Springer. https://doi.org/10.1007/978-3-319-58634-2_1

3. Chen, L., Song, Y., Guo, J., Sun, L., Childs, P., & Yin, Y. (2025). How generative AI supports human in conceptual design. *Design Science*, 11, e9. https://doi.org/10.1017/dsj.2025.2

4. Huang, Q., Willems, T., & Poon, K. W. (2024, October). Fostering lifelong learning on Gen-AI in the workplace. *NTU Annual Learning and Teaching Conference: From Good to Great 2024*, October 1–2.

5. Huang, Q., Willems, T., & Poon, K. W. (2024). The application of GPT-4 in grading design university students' assignment: An exploratory study. *arXiv*. https://doi.org/10.48550/arXiv.2409.17698

6. Poon, K. W. (2024, September 6). Three strategies to see if AI creativity is limited or limitless. *Design and Architecture.*

7. Poon, K. W., Lee, H., Lim, W. K., Mohan, R. E., Chae, Y., Balasubramanian, G., Yong, A. W. K., & Yeong, R. W. W. (2017). *Living digital 2040: Future of work, education, and healthcare*. World Scientific Publishing. https://doi.org/10.1142/10725

8. Poon, K. W., Willems, T., & Huang, Q. (2024). Future of AI: Six possibilities for educators (that were once impossible). *The HEAD Foundation Digest*, (12). https://digest.headfoundation.org/2024/07/10/future-of-ai-six-possibilities-for-educators-that-were-once-impossible/

9. Poon, K. W., Willems, T., & Liu, W. S. Y. (2023). The future of expertise: From stepwise domain upskilling to multifaceted mastery. In *International handbook on education development in Asia-Pacific* (pp. 1–19). Springer Nature Singapore.

10. Wadinambiarachchi, S., Kelly, R. M., Pareek, S., Zhou, Q., & Velloso, E. (2024). The effects of generative AI on design fixation and divergent thinking. In CHI '24: *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Article 380, pp. 1–18). Association for Computing Machinery. https://doi.org/10.1145/3613904.3642919

11. Willems, T. (2018). Seeing and sensing the railways: A phenomenological view on practice-based learning. *Management Learning, 49*(1), 23–39. https://doi.org/10.1177/1350507617725185

12. Willems, T., & Hafermalz, E. (2021). Distributed seeing: Algorithms and the reconfiguration of the workplace, a case of 'automated' trading. *Information and Organization, 31*(4), 100376. https://doi.org/10.1016/j.infoandorg.2021.100376.

13. Willems, T., Yaghmaei, E., & others. (forthcoming). Assessing employment and labour issues implicated by using AI. In E. Yaghmaei (Ed.), *Global perspectives on AI impact assessment*. Oxford University Press.

14. Willems, T., Huang, Q., & Poon, K. W. (2025, March). AI-empowered pedagogy in Singapore: A pioneer's reflection. *Artificial Intelligence in Education Series*. Hong Kong.

15. Willems, T., Huang, Q., & Poon, K. W. (2024, September). AIXEducation: Designing for a more inclusive future of education. *17th International Symposium on Advances in Technology Education (ISATE)*, September 24–27.

16. Willems, T., Poon, K. W., Lee, S. J., Liu, W. S. Y., Foo, H. T., Tanabal, S., Tay, P., Yang, S., & Ang, C. (2024). *Future of manufacturing: Crafting skills security and mastering uncertainty*. National Trades Union Congress, NTUC LearningHub, and SUTD.

17. Zemke, H., Stahmann, P., & Janiesch, C. (2025). Leveraging generative artificial intelligence for design thinking in creative processes: A literature review. In *Proceedings of the 58th Hawaii International Conference on System Sciences (HICSS-58)*. https://doi.org/10.24251/HICSS.2025.018

Other References

18. Bronowski, J. (1973). *The ascent of man*. Little, Brown and Company.

19. Cepelewicz, J. (2025, April 30). Mathematical beauty, truth and proof in the age of AI. *Quanta Magazine*. https://www.quantamagazine.org/mathematical-beauty-truth-and-proof-in-the-age-of-ai-20250430

20. Kestin, G., Miller, K., Klales, A., Milbourne, T., & Ponti, G. (2024). AI tutoring outperforms active learning (Version 1) [Preprint]. *Research Square*. https://doi.org/10.21203/rs.3.rs-4243877/v1