

Beyond pattern matching: Nurturing the human intelligence AI cannot replace



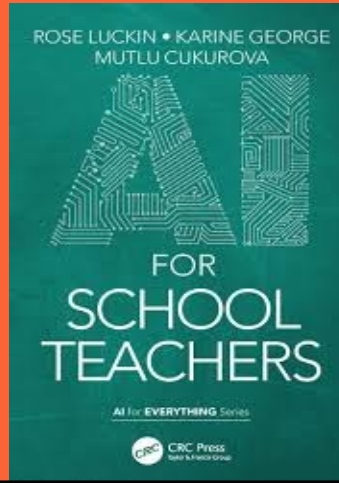
Machine Learning and Human Intelligence
The future of education for the 21st century

Rosemary Luckin

Prof. Rose Luckin CBE
Professor Emerita UCL
CEO & Founder EVR Ltd

EDUCATE
VENTURES RESEARCH

For all your AI needs: we help you realise the opportunity of AI





Today, we will explore:

1. The profound question we face: AI and Education: where are we?
2. What is Human Intelligence?
3. How do we enhance Human Intelligence through AI
4. Closing Thoughts.

“Learn Fast Act More Slowly”

Key Question

Are we preparing learners to thrive *with* AI, or are we inadvertently creating dependency *on* AI?

What is the data telling us about AI and Learning?

The visible gap

A national UK student survey, March 2026

Generative AI did not create the gap between submitting work and understanding it. It made that gap impossible to ignore.

47%

worry their grades do not reflect
what they actually know.

38%

admit submitting work they could
not fully explain.

Wonkhe (2026), Trained to Stop Learning. Survey of 1,055 UK students across 52 providers.

The real risk is not AI; it is unmanaged AI

Student adoption

More than nine in ten UK students now use AI tools, up from two-thirds just one year earlier.

Teacher preparedness

67% of US teachers received no AI training last year (Gallup, 2025). Only 25% were taught what AI actually is.

Policy and governance

Only 44% of executives report that their organisation has an AI policy, up from 10% in 2023. More than one in four companies have no policy and no plans for one (Littler, 2025).

Shadow AI

The majority of AI tools entering schools and workplaces are brought in by staff or students without employer knowledge or approval (Microsoft Work Trend Index).

The global policy response has been fragmented

Technology companies operate globally. Policy does not.

Users are not waiting for researchers to tell them something is wrong

Anthropic asked 80,508 people in 159 countries an open-ended question: what concerned them most about AI.

The 16 per cent figure matters because nobody prompted the answer. Users named it from direct experience of working with the tools.

27% named hallucinations and inaccuracy

22% named jobs and the economy

22% named loss of human autonomy and agency

16% named cognitive atrophy or erosion of critical thinking

Ganguli et al. (2026), Anthropic Claude User Survey: Hopes and Concerns About AI. 80,508 respondents, 159 countries, 70 languages.

Equity, who benefits?

AI adoption is not evenly distributed across subjects.

Aggregate adoption: 60.6 per cent. Subject-level adoption tells a different story.

Above the 60.6% average

Mathematical Sciences	77.8%
Computing	75.3%
Physical Sciences	72.9%
Engineering and Tech	70.0%
Business and Management	67.7%

Below the 60.6% average

Creative Arts and Design	46.4%
Humanities and Liberal Arts	41.6%
Language and Area Studies	36.8%

Add gender, ethnicity and socio-economic status, and the gaps compound.

Morgan et al., PAQ Wave 1, n=5,500 incoming undergraduates, September 2025.

The cognitive concern, in evidence

We are right to ask the question. The early evidence does point to a real risk, but also to a real path through it.

Bastani et al. (2025), PNAS

Students who practised with a general-purpose AI chatbot scored 17 per cent lower on closed-book assessments than peers without AI access.

Stadler, Bannert and Sailer (2024), Computers in Human Behavior

Students using a chatbot produced lower-quality reasoning and argumentation, with measurably reduced mental effort, compared to peers using a search engine.

Kosmyna et al. (2025), MIT preprint

Reduced brain activity and weaker recall in students using AI for essay writing, with the effect persisting after the tool was removed.

What is AI and how does it impact on education?

1

AI tools:

Using AI in education to tackle some of the big educational challenges

2

Increasing human intelligence:

Changing education so that we focus on human intelligence and prepare people for an AI world

3

Learning about AI:

Educating people about AI so that they can use it safely and effectively

Artificial intelligence in education

1

AI tools:

Using AI in education to tackle some of the big educational challenges

2

Increasing human intelligence:

Changing education so that we focus on human intelligence and prepare people for an AI world

3

Learning about AI:

Educating people about AI so that they can use it safely and effectively

Artificial intelligence in education



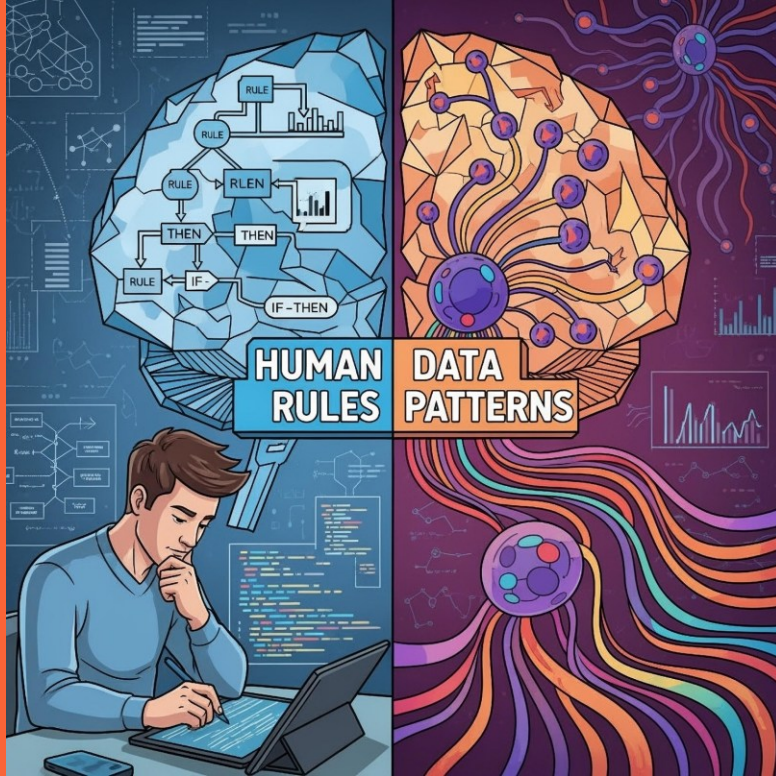
Technology that analyses its environment and acts with some autonomy to achieve goals.

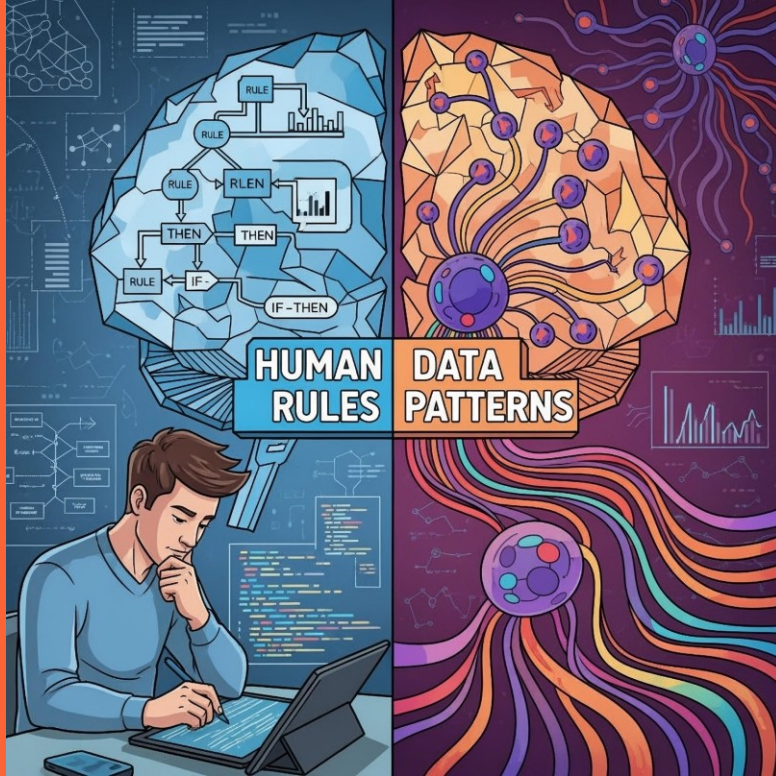
How do you use AI?

- Speech to text
- Chatbot assistant
- Analysis?

AI's history is important
Its Future is uncertain
AGI is not 'just round the corner'

GOFAI





GOFAI

= *Good old fashioned AI*

Machine Learning AI:

Finds insights, makes predictions, and helps automate decisions

Generative AI: a form of Machine Learning AI:

Creates new things, such as words, images and designs

+

November 2022: a defining moment?

Scaled, 'freely' available AI for anyone with an internet connection.

ChatGPT: 100M users in 2 months (vs Netflix: 10+ years).

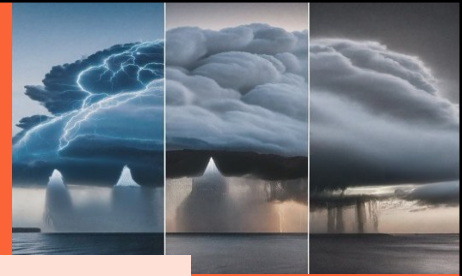
But Generative AI is 'The new kid on the block' - not the whole story.

More risky than non-generative AI – can still be a useful teaching tool.



The three ingredients of machine learning

Data, algorithms, computing: all three had to converge.



Data

- Trillions of words, billions of images, sensor streams.
- Machine learning thrives on examples.
- Quality matters as much as quantity: biased or unrepresentative data produces biased systems.

Algorithms

- Decision trees, support vector machines, neural networks, transformers.
- Different methods suit different problems. The transformer architecture, introduced in 2017, made today's large language models possible.

Computing

- GPUs and purpose-built AI chips running in data centres. Training a frontier model can use as much electricity as a small town for months.
- This concentrates AI development in well-resourced labs.

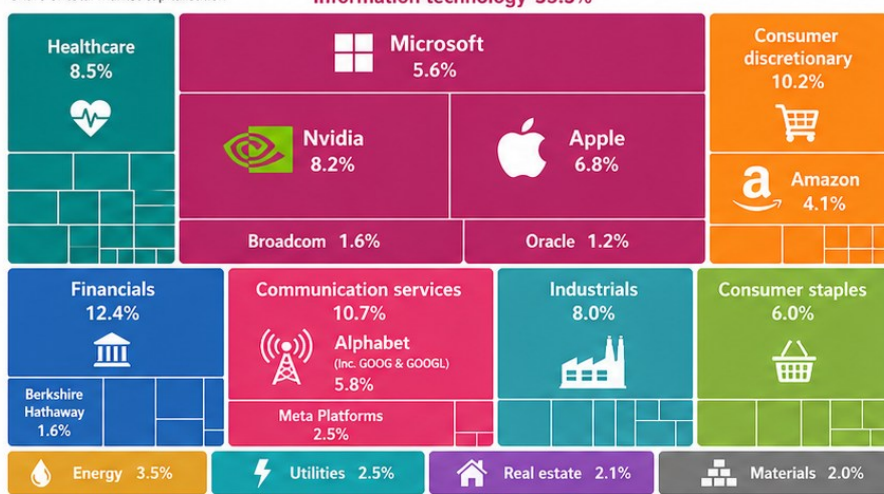
Until all three reached scale, machine learning could not deliver.
The recent surge is a convergence, not a single breakthrough.

The irresistible rise of Big Tech over three decades

S&P 500 by sector and market capitalisation, April 2026 (approximation)

S&P 500 by sector

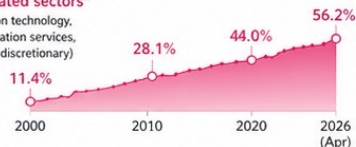
Share of total market capitalisation



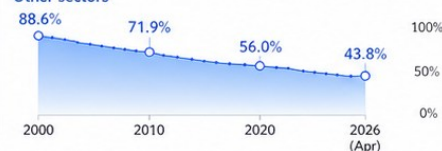
Tech-related sectors* vs other sectors

Tech-related sectors*

(Information technology, Communication services, Consumer discretionary)



Other sectors



*Tech-related sectors are a proxied grouping to highlight the economic footprint of Big Tech across sectors.

Source: Bloomberg

Graphic: Alan Smith, Hakyung Kim

© FT

Key takeaways (Apr 2026)

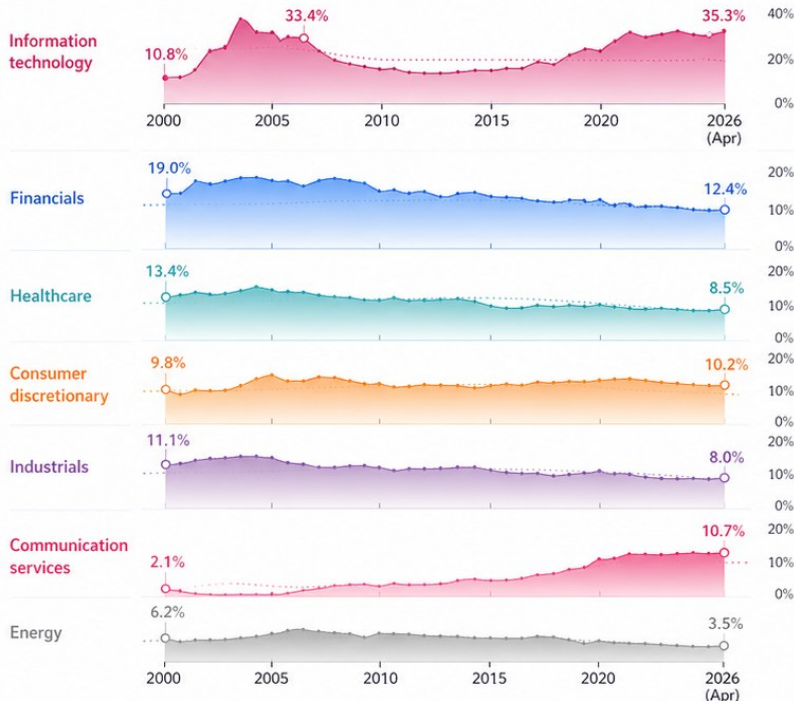
Information technology
35.3%
of S&P 500

Top 7 companies
~35%
of S&P 500

Tech-related sectors*
56.2%
of S&P 500

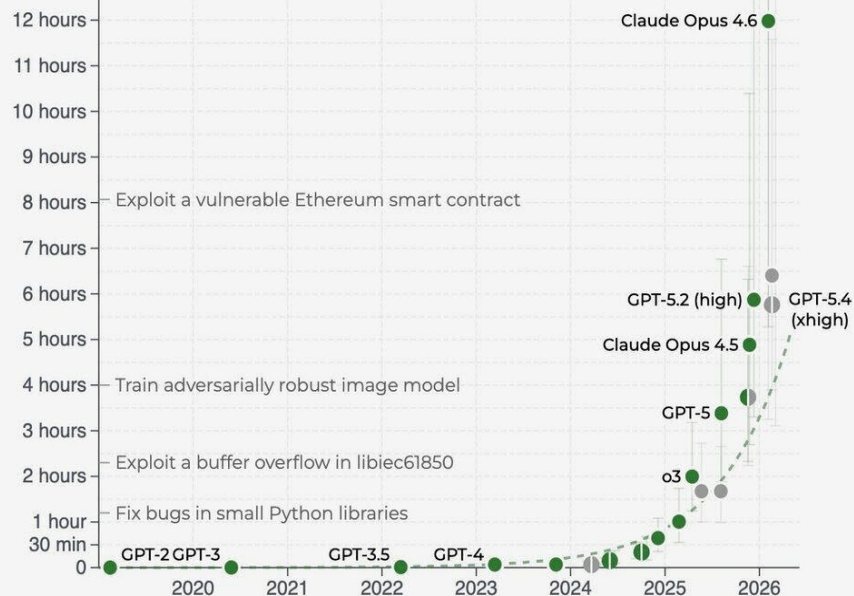
Share of S&P 500 market capitalisation (%)

— Sector share 20-year average



Consumer staples, Utilities, Real estate and Materials not shown for clarity (each <6%).

The METR time-horizon chart measures AI progress by tracking the length of task (in human hours) that an AI agent can complete reliably. The x-axis runs from 2020 to 2026, and the y-axis shows task duration from roughly 30 minutes up to 12 hours



Time Horizon 1.1 (Current) ▾

Log Scale

Linear Scale

50% Success

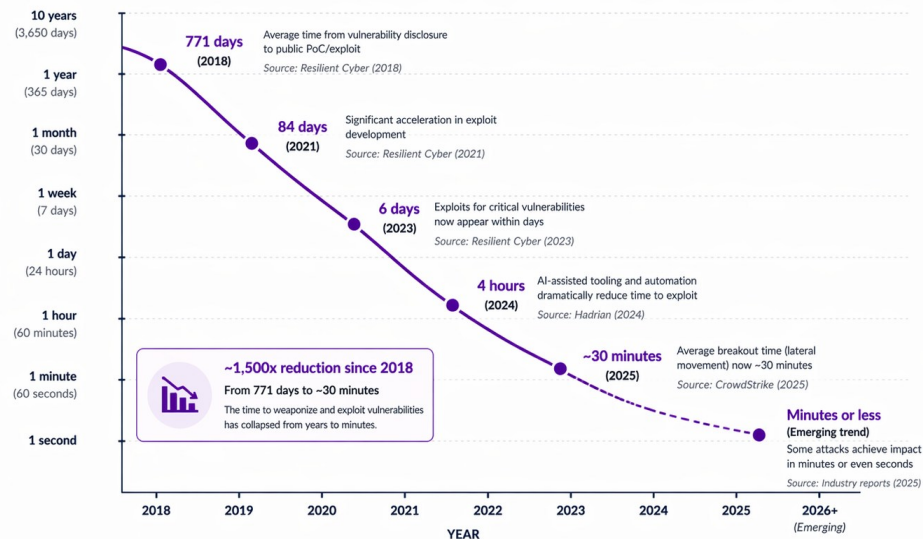
80% Success



From Years to Minutes: The Collapse of Time to Exploit

Real-world data shows how AI and automation have compressed the time to weaponize and exploit vulnerabilities.

TIME TO EXPLOIT A VULNERABILITY (log scale)



~1,500x reduction since 2018
From 771 days to ~30 minutes
The time to weaponize and exploit vulnerabilities has collapsed from years to minutes.

Time Horizon: 11 (Current) ▾

Log Scale

Log Scale

50% Faster Every Year

80% Faster by 2026



Note: Different studies use different methodologies and metrics. Data points represent the best available real-world industry research.

Sources: Resilient Cyber (2018, 2021, 2023) - "The Zero-Day Clock" | Hadrian (2024) - "The AI Offensive Security Boom" | CrowdStrike (2025) - "Global Threat Report 2025"

Where AI sits in children's lives right now

The question is no longer whether children will use AI. They already do.

In search

Google and Perplexity now answer with AI summaries before showing links. Children rarely click through.

In writing

Word, Google Docs and most school tools include rewriting, summarising and tone-checking features by default.

In study

Homework apps, language learning, maths support and revision tools are now AI-driven, often without children realising.

In social

Snapchat, Instagram and TikTok use AI to generate replies, captions, filters and recommendations.

The shift is that AI is no longer a tool to log into. It is woven into the tools children already use.

What is Human Intelligence?



Super Intelligence is possible and necessary for human society

We need to increase the sophistication of our human intelligence through developing advanced meta intelligence.

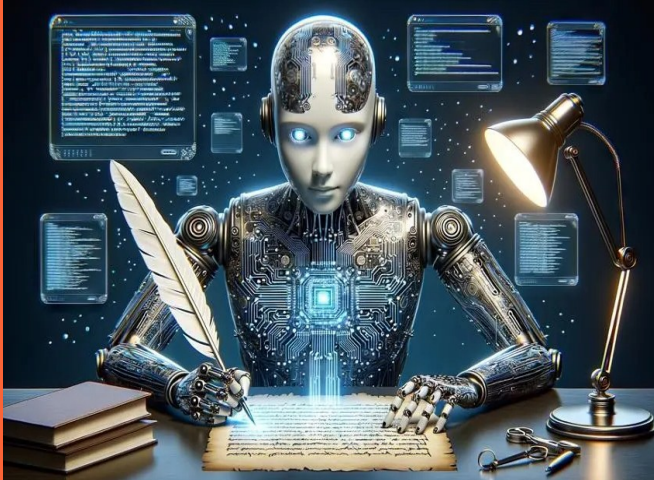
And we must beware of overreliance on AI.



Human and Artificial Machine
Intelligence are different



Humans and machines learn differently

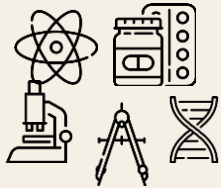




3. Social intelligence

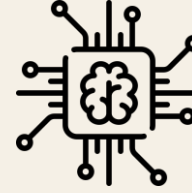


2. Meta-knowing intelligence



1. Interdisciplinary academic intelligence

4. Meta-cognitive intelligence



5. Meta-subjective intelligence

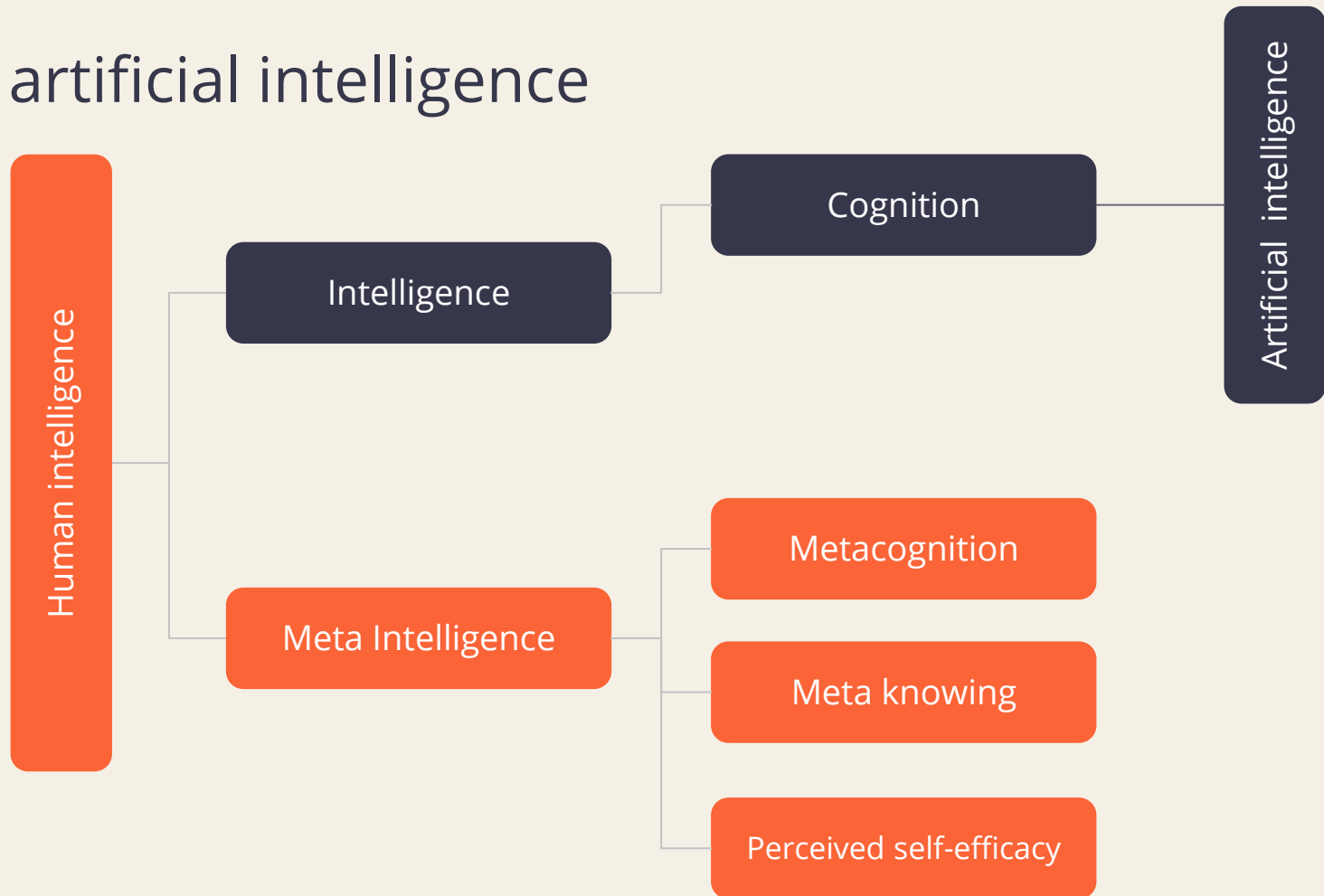


6. Meta-contextual intelligence



7. Perceived self-efficacy

Human vs artificial intelligence



What today's AI is good at:

- Pattern at scale Spotting structure across thousands of examples a person could not read in a lifetime.
- Drafting and reworking First drafts, summaries, translations, reformatting from one style to another.
- Generating options Ten ideas to react to is often better than a blank page. The reaction is the learning.
- Tireless practice Revising vocabulary, working through maths variations, simulating an interview, again and again.
- Explaining differently The same concept in a different language, at a different level, with a different example.

What today's AI is not good at, and probably will not be soon

This gap is the space learners need to develop into.

Knowing what is true

It generates fluent text. Fluency is not accuracy. Confident wrong answers are common, and called hallucinations.

Reasoning from first principles

It pattern-matches to similar problems it has seen. Truly novel problems expose this quickly.

Caring about the person in front of it

It cannot read your child's mood, motivation, history, or what they actually need today.

Judgement about what matters

It optimises what you ask it to optimise. Choosing what is worth doing in the first place is human work.

The exceptional learner

The north star every institution needs right now



Knows how to learn

Metacognitive capability that transfers across contexts and survives the next technology shift



Interrogates critically

Can distinguish signal from noise, question AI outputs, and reason from evidence



Knows themselves

Understands their own capabilities and limitations, can articulate what they know to an employer



Collaborates with AI

Works with AI as a tool, not a replacement, retains agency over their own intellectual life

Enhancing Human Intelligence through AI

Example: How can we leverage AI to support metacognition?



- **Prompts and Scaffolds:** Guiding students to apply metacognitive strategies and self-regulation
- **Progress Tracking:** Real-time feedback on performance and goal achievement
- **Learning Analytics:** Digital traces of planning, monitoring, and reflection behaviours
- **Personalised Dashboards:** Visual representations of learning progress and metacognitive knowledge
- **Adaptive Support:** Systems that adjust to individual metacognitive needs and provide targeted interventions

Example: How can we leverage AI to support metacognition?



Video Platforms + AI Curation

- Ask an LLM: "Find educational videos that teach note-taking strategies for my Year 8 class" - create personalised playlists.

Text-Based Applications

- Metacognitive conversation partner
- Strategy generator and evaluator
- Reflection facilitator with specific example prompts

Voice Recognition Applications

- Think-aloud recording with transcription
- Voice-based learning journals
- Strategy verbalisation capture

Examples from the Shape the Future Coalition

EDUCATE

VENTURES RESEARCH

[About Us](#)[AI Services](#)[Thought Leadership](#)[The Skinny Newsletter](#)[Resources](#)[Contact](#)

[Connect with us on LinkedIn for daily intelligence on AI](#) [Sign in](#)

Shape the Future Leaders Coalition

Supported by Professor Rose Luckin and Educate Ventures Research

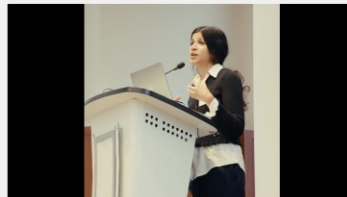
The Shape the Future Leaders Coalition serves those involved in school leadership, including the many stakeholders working within and around schools, to support safe, purposeful, and intelligent approaches to the use of AI by young people and the school workforce.

If you're a senior leader in your school or trust, apply below to join today. All schools are eligible to join.

Shape the Future Leaders Coalition

The Coalition consists of education system leaders from schools, Multi Academy Trusts, and school groups, who collectively represent leadership in over 400 schools, encompassing approximately 32,000 staff, and ¼ million young people across England.

The Coalition serves those involved in school leadership, including the many stakeholders working within and around schools, to support safe, purposeful, and intelligent approaches to the use of AI by young people and the school workforce.

[Join here](#)

Caterham Prep

Strand 1: AI & Digital Pedagogy

Gains, losses and complexity when introducing AI formative feedback into lessons. Redesigned pedagogy, pupil independence and self-efficacy, and alignment with the school learning framework.

Research Questions

- 1 How can student-facing AI-enabled formative feedback support adaptive teaching?
- 2 How does structured AI use affect pupil independence and self-efficacy?
- 3 How do lesson planning frameworks guide effective AI implementation across different age groups?



Image created by ChatGPT

Led by Deputy Head Lex Lang | Caterham Family of Schools | Building on 2024 RileyBot action research

Caterham Prep

Custom AI to support student autonomy, aligned with a new learning framework



- ✓ Students who used the AI tool most frequently showed the strongest gains in self-reported **independence** and **sense of agency** in their learning
- ✓ Children who embraced the new learning framework showed **better learning triage skills**, suggesting the tool can support metacognitive development
- ✓ Where teachers modelled and talked about the tool positively, children mirrored that attitude
- ✓ Three iterative studies allowed the team to identify that **implementation and culture**, not just the tool itself, **were the critical variables**
- ❖ Study two showed virtually **no measurable impact**, and the core reason was that without active championing and micromanagement from the lead researcher, most teachers and students simply **stopped using the tool**
- ❖ Technical problems in the early stages put off some older students permanently
- ❖ Younger students (the equivalent of years 3 and 4) struggled to interact with the tool effectively without significant adult guidance, raising questions about the **appropriate age for introduction**
- ❖ **Teacher resistance** was a significant barrier

Stretford High

Strand 3: AI, Equity & Digital Divide

Exploring how AI tools can support Teaching Assistants and SEND + Pupil Premium students in low-resource classroom settings.

Research Questions

- 1 In what ways can AI be used to support Teaching Assistants when giving feedback to multiple SEND students in an in-class writing exercise?
- 2 Can the TA's use of an AI tool enhance SEND students' subject-based learning and also support AI familiarity?
- 3 What are the challenges and opportunities when introducing AI tools into the writing process in a low-resource setting?
- 4 How does the training and use of an AI teaching tool affect TAs' professional experience?



Image created by ChatGPT

Led by Deputy Headteacher Rowena Kidd | Stretford High School

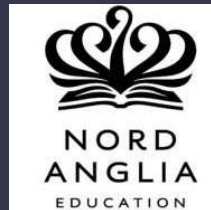
Stretford High

Focussing AI development for TAs working with double disadvantaged students



- ✓ Targetted, personalised feedback that **frees up the TA** to work with other students
 - ✓ Helped a SEND student who needed **constant reassurance** about mark allocation; gave him the scaffolding he needed without demanding teacher time
 - ✓ Useful for **non-specialist TAs** or those covering multiple subjects, since the AI can supply subject knowledge they may not have
 - ✓ Supports **equity**: gives disadvantaged students access to AI tools and skills they might not otherwise encounter
- ❖ Some high-dependency SEND students rely on tone of voice and facial expressions to feel safe; the **AI cannot replicate that relational element**
 - ❖ The interface is not yet student-friendly enough for sustained independent use; **students still need adult guidance** to navigate prompts effectively
 - ❖ TAs and teachers unfamiliar with the subject may take time to learn which prompts are most useful; **initial uptake may feel like an extra burden**
 - ❖ **Time pressure** in fast-paced lessons (especially English) is a challenge; students using the app risk missing whole-class teaching

Assessment redesign



If AI changes what “work” means, assessment has to change with it. The shift is from product to process — from what students hand in to what they can show, explain and defend.

SHOW THE WORK

Students show the prompts they used, explain their reasoning, and demonstrate process: not only the final product.

STAGE THE WORK

Major pieces are produced in stages with checkpoints, so learning is visible across the work, not only at the end.

SPEAK THE WORK

Greater emphasis on oral and spoken assessment: students explaining their thinking aloud, where AI cannot stand in for understanding.

Closing thoughts

To close

The question is not whether a child will use AI.
They will.

The question is what they will bring to it.

Curiosity. Judgement. Integrity.
The willingness to think before they prompt.



Age-appropriate is not optional

There is no single right answer. The right answer changes with the learner.

Early years

Ages 3 to 6

The priority is human input, language, play, relationship. AI does not need to be in the picture. Read aloud, talk, slow down.

Primary

Ages 7 to 11

Show and illustrate AI rather than hand it over. Most tools are 13+, so the work here is building vocabulary and intuition through conversation.

Lower secondary

Ages 12 to 14

Introduce supervised use where age policies allow. Sit beside them. Ask: "What did you ask it? What do you think of what it said?"

Upper secondary

Ages 15 to 18

Move from supervision to partnership. Discuss explicitly what is being outsourced and why. Protect time for unaided thinking.

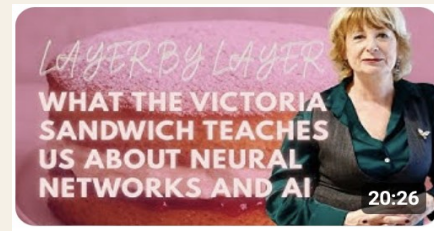


If you can bake a Victoria sandwich, you can understand neural networks

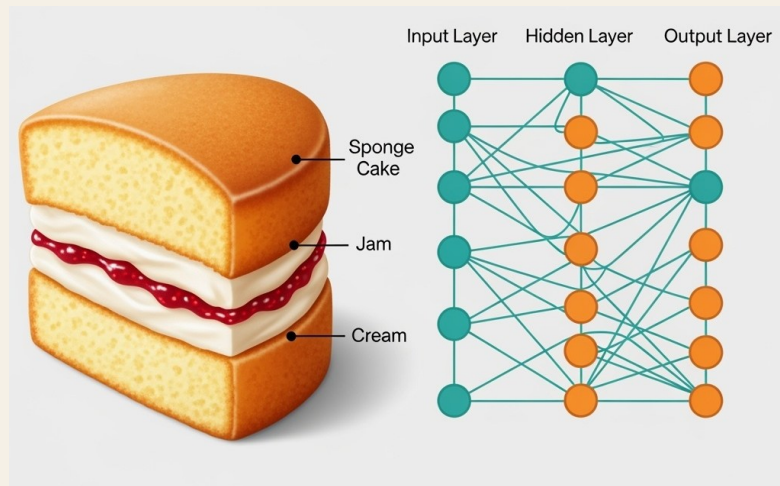
[youtube.com/@roses_ai](https://www.youtube.com/@roses_ai)

Each layer of cake = each layer of AI processing

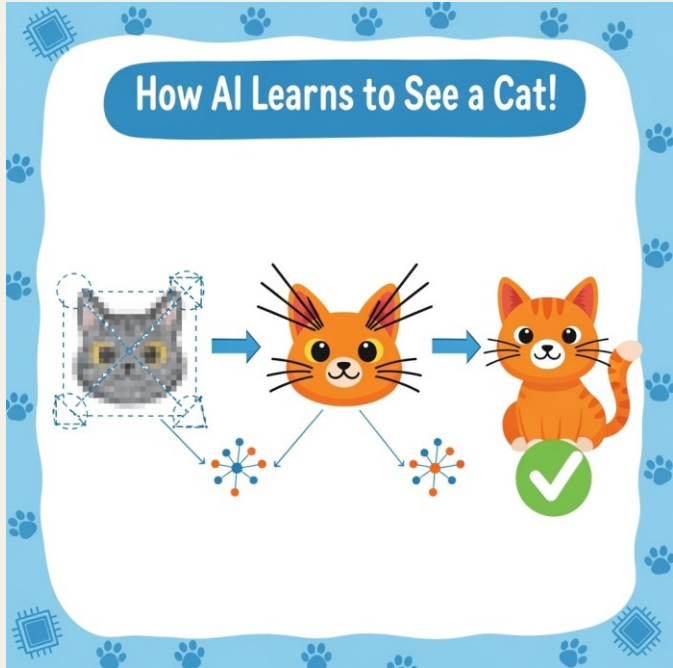
- **Input layer:** raw ingredients = your words/data going into AI
- **Hidden layers:** the transformation in the oven = AI processing patterns
- **Output layer:** the finished cake = AI's response



"AI transforms information layer by layer, just like baking transforms ingredients into deliciousness."



The Victoria Sandwich Lesson for Image Processing



AI Photo Recognition:

"Is this a cat?"

Understand what each layer sees:

- **First Layer (Input):** The photo breaks into tiny pieces - colours, edges, shapes
- **Hidden Layers:** "I see pointy triangles + round shape + whiskers = cat ears and face!"
- **Output Layer:** "Yes, this is a cat!"

AI looks at pictures layer by layer, starting with simple things (is it bright? dark? curvy? straight?) and building up to understanding what the whole picture shows!



Please reach out for more
information
rose@educateventures.com



CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT



<https://www.linkedin.com/feed/>

THE SKINNY

on AI for Education

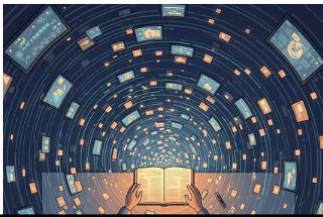
Issue 25, February 2026

Welcome to *The Skinny on AI for Education* newsletter. Discover the latest insights at the intersection of AI and education from Professor Rose Luckin and the EVR Team. From personalised learning to smart classrooms, we decode AI's impact on education. We analyse the news, track developments in AI technology, watch what is happening with regulation and policy and discuss what all of it means for Education. Stay informed, navigate responsibly, and shape the future of learning with *The Skinny*.

Headlines

- [*The Cognitive Paradox: design AI use around cognitive objectives, not convenience or speed*](#)
- [AI News Summary](#)
 - [AI in Education](#)
 - [AI Ethics and Societal Impact](#)
 - [AI Employment and the Workforce](#)
 - [AI Development and Industry](#)
 - [AI Regulation and Legal Issues](#)
 - [AI Market and Investment](#)
- [Further reading: find out more from these resources](#)

The Cognitive Paradox: design AI use around cognitive objectives, not convenience or speed



<https://www.linkedin.com/feed/>

WEEKLY BRIEFING #1 • WEEK OF 3 MARCH 2026

AI Landscape

Through Three Lenses

THE NUMBER THAT MATTERS

68%

of US teachers have received no AI training at all. Fewer than 1 in 3 got guidance on effective use.

Gallup 2025

68%

AI as Tool

What educators can use

- AI tutoring needs guardrails that scaffold, not replace
[Anthropic Research](#)
- A £100 device changes institutional AI access
[FT Lex](#)
- Agentic AI needs governance before deployment
[AWS / FT](#)

AI as Catalyst

What humans need to develop

- The Jevons Paradox comes for cognitive work
[Harvard Business Review](#)
- Cognitive debt is real and measurable
[Kosmyna et al. / MIT](#)
- AI matching gold-medal olympiad performance
[Google DeepMind](#)

AI as Subject

What people need to understand

- The people building AI safety are leaving
[FT / NYT](#)
- AI chatbots causing 'romantic delusions'
[FT 'Artificial Intimacy'](#)
- EdTech faces existential repricing
[Goldman Sachs / Bloomberg](#)

Thank you

SOURCES

- Studiosity–YouGov (2025). Singapore Student Wellbeing Report 2025. n=1,027.
- Studiosity–YouGov (2026). Global Student Wellbeing Survey: Caught in the Crossfire. n=10,330 across eight countries.
- Wonkhe (2026). Trained to Stop Learning: How Students Are Experiencing Assessment and Learning in an Age of AI. Secret Life of Students 2026. Wonkhe Ltd.
- Bastani, H. et al. (2025). Generative AI and learning. Proceedings of the National Academy of Sciences, 122(26).
- Stadler, M., Bannert, M. and Sailer, M. (2024). Cognitive ease at a cost: LLMs reduce mental effort but compromise depth in student scientific inquiry. Computers in Human Behavior, 160, 108386.
- Kosmyna, N. et al. (2025). Your brain on ChatGPT: accumulation of cognitive debt when using an AI assistant for essay writing. arXiv:2506.08872.
- Ganguli, D. et al. (2026). Anthropic Claude User Survey: Hopes and Concerns About AI. Anthropic Societal Impacts.

FURTHER READING

- Luckin, R., "Machine Learning and Human Intelligence" (UCL IOE Press)
- Luckin, R. et al., "AI for School Teachers" (Routledge)
- Lee et al., "The Impact of Generative AI on Critical Thinking" (MS Research / CMU, 2025)
- Royal Society, "Children and AI" insights (2026)