AI and Mathematical Modelling Education

Stanley Lee

6 June 2026



Flows

01 Mathematics development in pre/post-AI era

02 Mathematics for human and mathematics for machine

03 What should (mathematics) education look like in post-AI era?

04 Roles of AI in mathematics education

05 Conclusion

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> *“the Earth was just one planet among countless others in the universe, receiving no preferential treatment whatsoever from the fundamental laws of nature.”*

Tanya Klowden & Terence Tao

“Mathematical methods and human thought in the age of AI”

Source: https://arxiv.org/pdf/2603.26524

From human-centric to a “Copernican View”

Human Intellectual Activity

The nature of mathematics as a purely human-driven creative and intellectual endeavor.

Pattern Connection

Mathematics as an objective discovery of underlying structures and connections in nature.

Co-existing Intelligence

A new paradigm where human and machine intelligence collaboratively explore mathematical truth.

Source: https://arxiv.org/pdf/2603.26524

Changing Problem Landscapes

Technical Problems

Solving equations, executing long proofs, computing large datasets.

(Increasingly solved by AI instantly)

Philosophical Problems

Why does this matter? What is the structure? Is the premise sound?

(The new frontier for human mathematicians)

Source: https://arxiv.org/pdf/2603.26524

Timothy Gowers's Experiment



vs PhD Level

- ChatGPT 5.5 solved a PhD level problem in additive number theory, and wrote a paper within hours.
- No human mathematical input at all.

Source: https://gowers.wordpress.com/2026/05/08/a-recent-experience-with-chatgpt-5-5-pro/#more-6666

Erdős Planar Unit Distance Problem

The Unit Distance Problem

Erdős (1946): What is the maximum number of unit-distance pairs in a set of n points?

A foundational challenge in discrete geometry.

AI Disproof

AI identified configurations exceeding Erdős's conjectured upper bound, breaking a decades-old mathematical assumption.



Source: https://openai.com/index/model-disproves-discrete-geometry-conjecture/

The Dual Effect of AI



Raising the Bar

For researchers: Pure technical skill is no longer enough. Creativity and novel conceptualization are mandatory.



Lowering the Bar

For laymen: Accessing, visualizing, and applying complex mathematical knowledge has never been easier.

SIAM Survey (March 2025)

56%

of high school students

Reported that AI usage **reduced** their overall math anxiety.

Source: https://m3challenge.siam.org/newsroom/artificial-intelligence-math-anxiety/

Interpreting the Data

⚖️ **Biased sample?** Participants of M3 Challenge

❓ **The Root Cause:** If a chatbot reduces anxiety, what caused it originally?

The Shift: AI removes the penalty for slow mechanical processing, shifting focus to concept.

Flows

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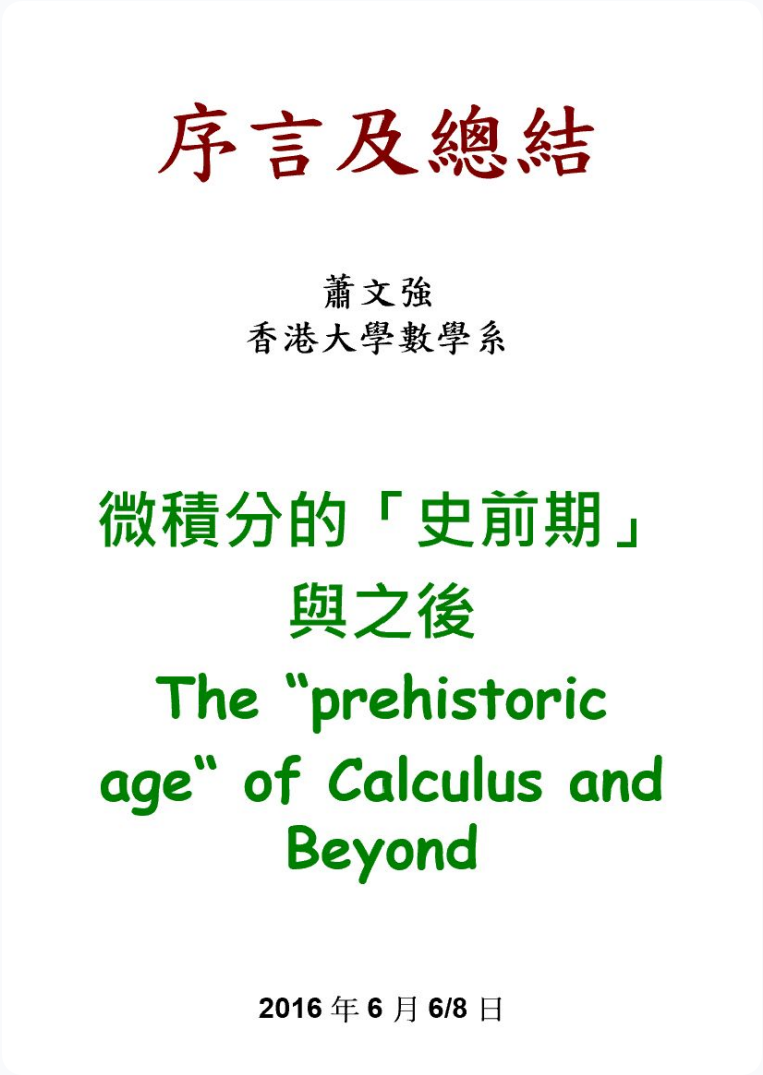
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Today, a decade ago


序言及總結

蕭文強
香港大學數學系

微積分的「史前期」與之後
The "prehistoric age" of Calculus and Beyond

2016 年 6 月 6/8 日

"With calculus, an average person could handle problems that originally required a genius to solve."

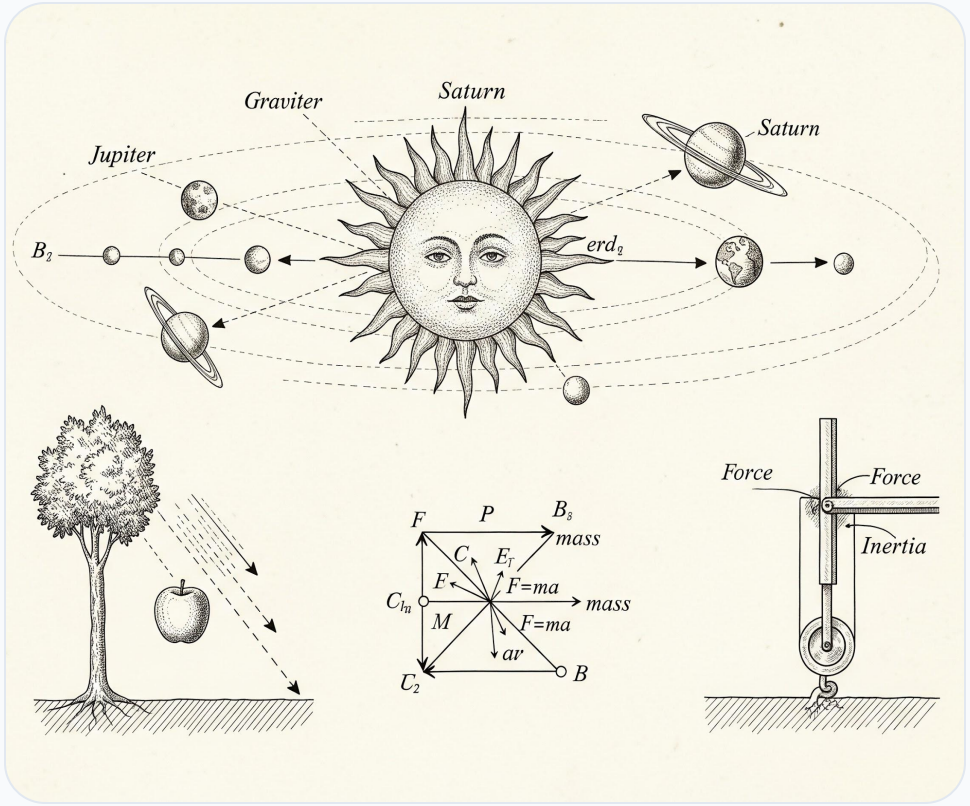
Which question is more suitable for machine?

Let $f(x) = x^2 \ln x$, where $x > 0$.
Find $f'(x)$ from first principles.

How can we symbolise the idea of an infinitesimal changes of variables through mathematical language?

Which question is more interesting to human?

Newton's "World System": From Motion to Calculus



The Real-World Challenge

Dynamics of Planetary Orbits

Proving elliptical orbits from gravity required describing **continuously changing motion**, beyond the limits of static geometry.

The Calculus Solution

Fluxions and Moments

Newton created **"Fluxions"** (derivatives) for velocity and **"Moments"** (infinitesimals) for area/displacement.

"We do not assume the existence of a limit, but consider the limit notion as something that has to be defined. " — Karl Weierstrass

Mathematical modelling or development?

- 🔗 **Deep Similarity:** The history of math development closely mirrors the process of mathematical modelling.
- 💡 **The Spark:** Both begin with observing a real-world pattern, not a blank sheet of equations.
- 🔧 **The Tool:** Both require building a structure to explain the pattern.

Proofs and machine proofs: Formalisation



Source:
https://wapbaike.baidu.com/tashuo/browse/content?id=287cbd9a63087aaeaaf47020

Early 20th Century: The Foundational Quest

Hilbert's Program (Beweistheorie)

Proposed that mathematical proof is decidable through a finite number of operations, aiming to justify abstract math via formal consistency.

1930s: The Logical Limit

Gödel's Incompleteness Theorems

Challenges the contemporary belief that formalising a system could eventually exhaust all theorems to be developed within it.

Modern Era: Automated Reasoning

Logicist Cognitive Science & Formalism

Shift toward using computers for absolute formalisation and logical step-by-step verification without human gaps or intuition.

What are the reasons to learn routines and memorise facts in mathematics then?

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A robot that would run faster than Usain Bolt?

How is it meaningful to compare the running speed of a robot and a human?

Is human brain indeed efficient in computation?



Source: https://news.now.com/home/local/player?newsId=643297&refer=Share&utm_source=now_appshare&utm_medium=share

SuperTA AI Tool developed by HKU

- **TACO Framework:** Think, ask, check, **own**
- **Assessment analyser:** "The education ecosystem and mindset need to change."
- **Co-working:** Teachers and students must learn to co-pilot with AI, not compete with it.

Source: https://www.keynotes.hku.hk/story/super-ta/

Humanistic-focused mathematics education

Defining Purpose: What and why to calculate in addition to how

Contextualizing: Understand the intervening relationship between context and problem

Value judgement: Decision making based on the choice of preference/value before communicating

Communicating: Translation between thoughts and math language.

Philosophy of curriculum development

- **Rule of thumb:** Time and resources are limited in a curriculum
- **Choice of topics:** How do the topics lead us to think?
- **Foci of topics:** When are we focusing on the algorithm, or the structure?
- **The Ultimate Goal:** Can knowledge point to a build-up of a mathematical mind?

Example 1: Division

- What is the purpose of comparison?
- What assumptions before we can use division?
- Does division give us fair comparison?
- How should we choose the divisor according to context?
- What else for consideration?





Example 2: The Addendo Identity

Addendo rule:

If: $$\frac{a_1}{b_1} = \frac{a_2}{b_2} = \frac{a_3}{b_3} = \cdots = \frac{a_n}{b_n}$$, then

$$\frac{a_1 + a_2 + a_3 + \cdots + a_n}{b_1 + b_2 + b_3 + \cdots + b_n} = \frac{a_1}{b_1}$$

- Why was this property removed from the curriculum?
- What was learning this property pointing in building up mathematical mind?

Two ways to learn mathematical modelling

Application

Applying learnt mathematical knowledge to solve real-world problems. (Extended activities).

Development

Aware of a real-world problem, and develop/learn a new mathematical tool to handle it. (True modelling).

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Being an advisor of a school on AI policy…

Prevention or empower?

Using AI for completing assignments?

Students never copy assignments before AI?

Does AI cause the decline of academic honesty, and why?

Can AI empower students' self-directed learning, and how?



Bloom’s Taxonomy + RAT Framework

Bloom's Taxonomy



RAT Framework

Replace

Remembering & Understanding: Easily *Replaced* by AI as a medium.

Amplify

Applying & Analysing: Can be heavily *Amplified* by AI tools.

Transform

Evaluating & Creating: Fundamentally *Transformed* through human-AI collaboration.

Examples of replaceable teachers' works by AI

Procedural checking

Validating or correcting steps in students’ works.

Marking assignments

Automated grading for objective assignments and quizzes.

Instruction on working examples

Generating repetitive instructional content and sample problems.

HKDSE marking

HKEAA has sufficient data to train an AI system if they want.



Examples of amplifiable teachers' works by AI

AI-powered flipped classroom

- Procedural learning with AI
- Interactive and tailored learning by AI
- Meaningful human interaction in class on mathematical mind



Examples of transformable teachers' works by AI

- **Co-piloting:** Collaboration between teacher, students, and AI for problem solving (with coding).
- **Future e-assessment:** Moving away from standard tests to real, interactive assessments focusing purely on thinking process.

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2026 Univ. of Tokyo Entrance Exams

- **ChatGPT 5.2 Math scored full marks.**
- Both arts and sciences AI models outperformed human candidates.
- The wave has already been hitting hard.

Source: https://www.businessweekly.com.tw/international/blog/3021250



"Everyone would be replaced if we view education the same.

Be transformative."

Stanley Lee

References

01 Business Weekly. (2026). *2026 Univ. of Tokyo Entrance Exams Analysis*. https://www.businessweekly.com.tw/international/blog/3021250

02 Gowers, T. (2026, May). A recent experience with ChatGPT-5.5 Pro. *Gowers's Weblog*.

03 Klowden, T., & Tao, T. (2026). Mathematical methods and human thought in the age of AI. *arXiv*. https://doi.org/arXiv:2603.26524

04 NOW News. (13 April 2026). 宇樹稱旗下機械人跑出每秒 10米峰值速度　直逼人類極限 . https://news.now.com/home/international/player?newsId=643297

05 OpenAI. (2026). *Model disproves discrete geometry conjecture: Erdős Planar Unit Distance Problem*.

06 University of Hong Kong. *SuperTA AI Tool: The education ecosystem and mindset need to change* [Keynote address].