



An Institute of



Computational Thinking, Data Science and AI: Singapore Practices

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Computational Thinking, Data Science and AI in the Singapore Education System

Curriculum Integration (General)

- Code for Fun (primary & secondary students) → expose students to computational thinking concepts and ideas of coding.
- AI for Fun → expose students to basic AI concepts, generative AI, smart robots and responsible use of AI tools.
- Computing for O-Levels → expose secondary students to computational thinking and programming skills.
- Data Science → not much independent work but a re-examination of the statistics component of the mathematics curriculum.



AI for Teaching and Learning – a Singapore experience

AI for Student Learning

Adaptive Learning System (ALS) to personalize student learning. Based on students' responses, the system

- Adjust content difficulty
- Suggest the next step for student learning
- Suggest appropriate practice based on students' level of mastery
- *ALS proposes an appropriate learning trajectory for each student*

The screenshot displays the user interface of the Adaptive Learning System (ALS) for Mathematics. At the top, an orange banner reads "Adaptive Learning Start learning today!". Below this, a section titled "My Learning Goals" is highlighted with a red border. It contains three goal cards: "Concepts" showing 0 actual and 2 target, "Learning Time" showing 00:00 actual and 00:30 target, and "Word Problems Involving" with a progress bar. A notification bar below states "More topics on the way New topics are added from time to time. Check this space again soon." The main content area is titled "(ALS) MATHEMATICS" and features a "TEST MYSELF" button. Three topic cards are shown: "Percentage" with a car icon, "Ratio" with a pie chart icon, and "Algebra" with mathematical symbols like x , $a - 3$, $3y$, and $\frac{x}{4}$. Each card includes an "OVERALL MASTERY" progress bar.

AI for Teaching and Learning – a Singapore experience

AI for Student Learning

AI-Powered Feedback System provides

- Step-by-step hint / feedback
- Short answer feedback
- AI marking of student work

Although teachers are spared of repetitive grading of students' work, teachers remain important to ensure students' learning and are expected to review all AI-generated feedback for students.

The screenshot shows a digital learning interface for a proofreading task. At the top, the title is "5. Proofreading" with a sub-header "AI-powered feedback compatible" circled in blue. The main content area displays the instruction: "Modify the noun error in the box below." Below this, a definition states: "Modify means to change something, usually in order to improve it." A text box contains the sentence: "Charlie and Awahi were given a special responsibility—they got the lock to the Sports Shed, which meant they could unlock the door at any time to help the teacher organise class games!" Below the text box is a rich text editor with a toolbar. A "Check Answer" button is visible. At the bottom, a note states: "This is an AI-compatible question. If AI is enabled, students will receive AI-generated feedback for this question, and are given an estimated star rating. If AI is disabled, students will self-assess. Regardless of AI usage, teachers can manually review and provide feedback on this question." The interface also includes a sidebar with a list of tasks, a "Send us Feedback" button, and navigation controls like "Previous 31 of 38 Next" and "Fullscreen".

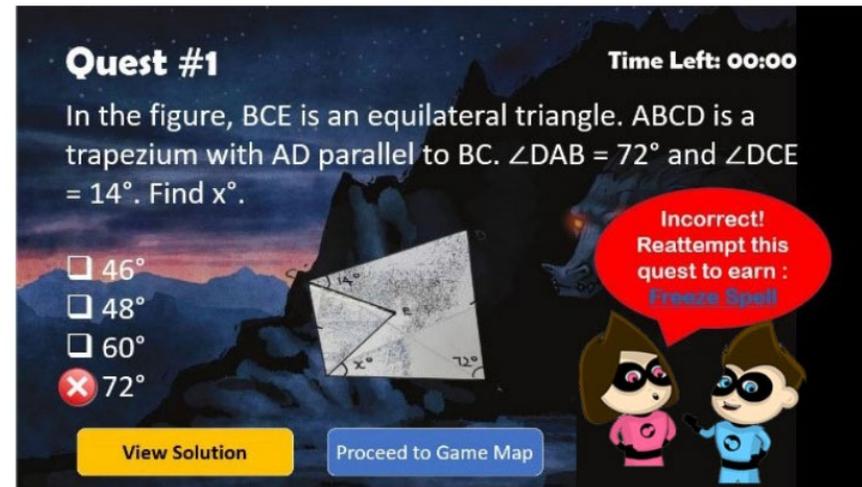
AI for Teaching and Learning – a Singapore experience

Even before the era of AI, Singapore has been exploring

Adaptive feedback for students' work – largely based on teachers' PCK and alternative conception framework.

→ **Developing MCQ and distractors**

→ **Game-based assessment**

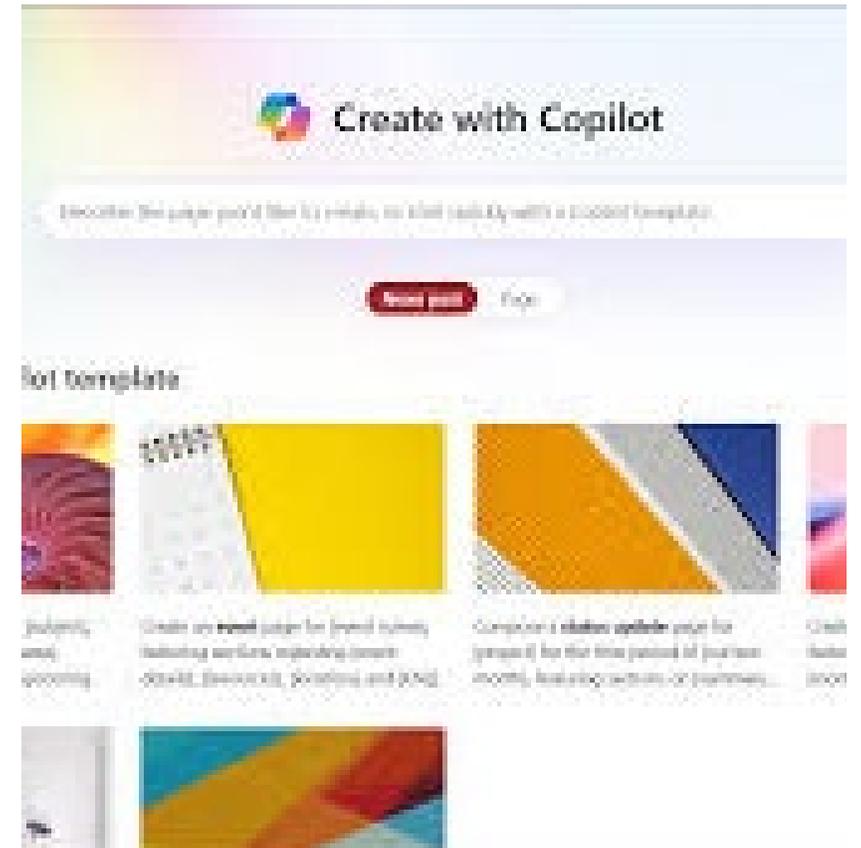


AI for Teaching and Learning – a Singapore experience

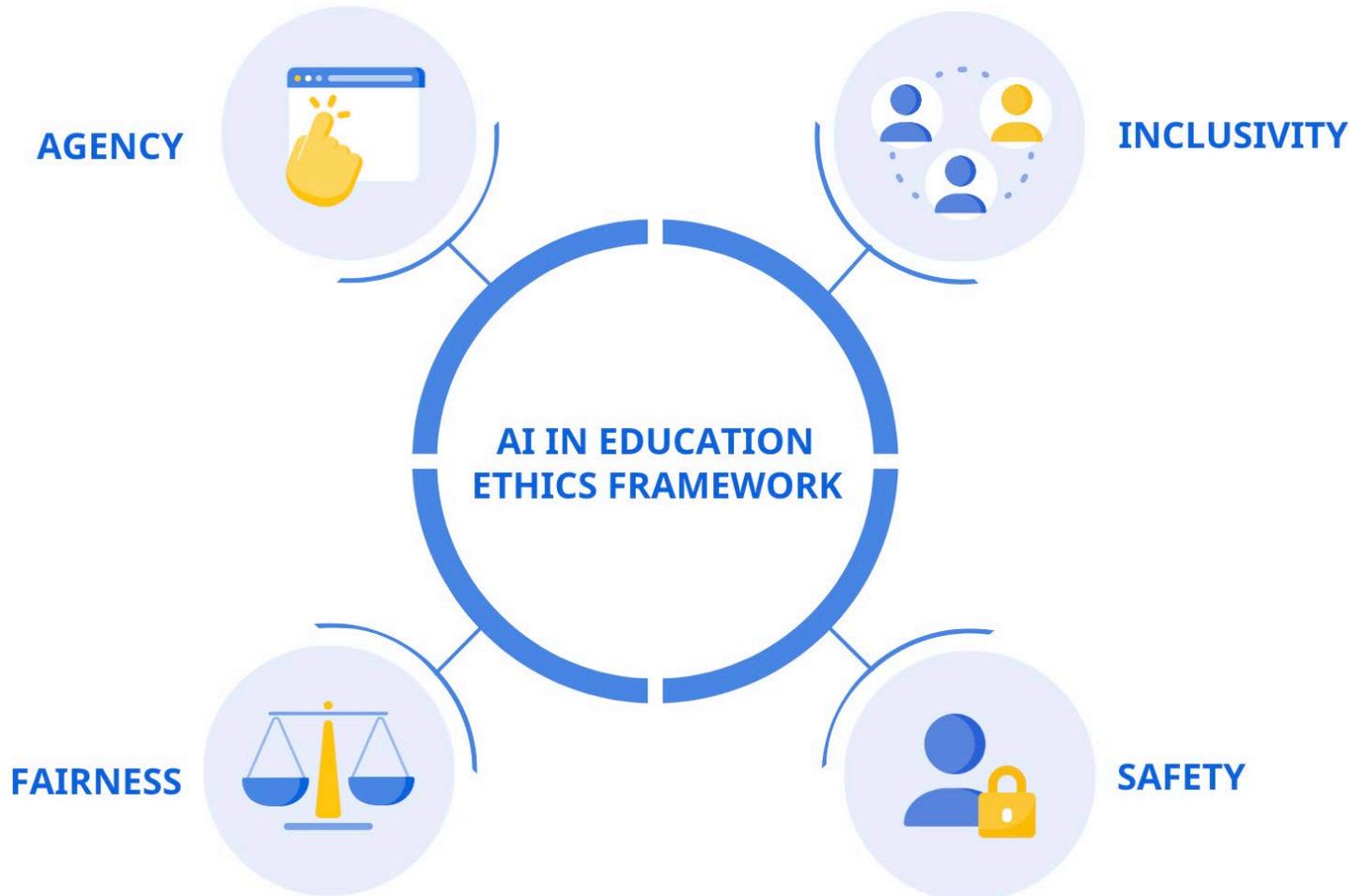
AI for Teacher Teaching

Authoring Copilot (ACP) assist teachers to generate their lesson plans by providing input to

- Topics and levels
- Instructional objectives
- Appropriate lesson plans with suggested activities, questions aligned to the instructional objectives and topics will be generated.



AI for Teaching and Learning – a Singapore experience



MOE AIEd Ethics Framework

<https://www.learning.moe.edu.sg/ai-in-sls/responsible-ai/ai-in-education-ethics-framework>

AI for Teaching and Learning – a Singapore experience

MOE AIEd Ethics Framework for the use of AI

- Agency – teachers' and students' choice over important professional and personal decisions
- Inclusivity – all users should benefit, regardless of background
- Fairness – equip teachers with accurate information to address students' learning gaps and promote positive impact on students
- Safety – learners' interests, privacy and well-being

MOE's Position on AI Use in Education



1



Singapore will teach students **about AI, to use AI and learn with AI** in schools and IHLs.

2



Educators will use AI, blended with other approaches, when it is **beneficial for students' learning**.

3



Guardrails and teaching scaffolds are to be put in place to mitigate the **misuse of AI** and **negative impact** on learning and development.

4



There will be **light and supervised use** of AI for younger students. Use of AI must be age and developmentally appropriate.

5



Older students will learn to **harness AI ethically** to **augment their capabilities** in life and at work.

6



Schools and IHLs will **enhance** the teaching of **other skills** needed by students to **thrive in an AI world**.

MOE's Position on AI Use in Assessment

1



The use of AI in assessment must **align to learning outcomes** and instil confidence that the **assessment outcomes truly reflect the intended mastery** by students.

2



Students must be **responsible for their own learning** and taught the importance of **academic integrity**.

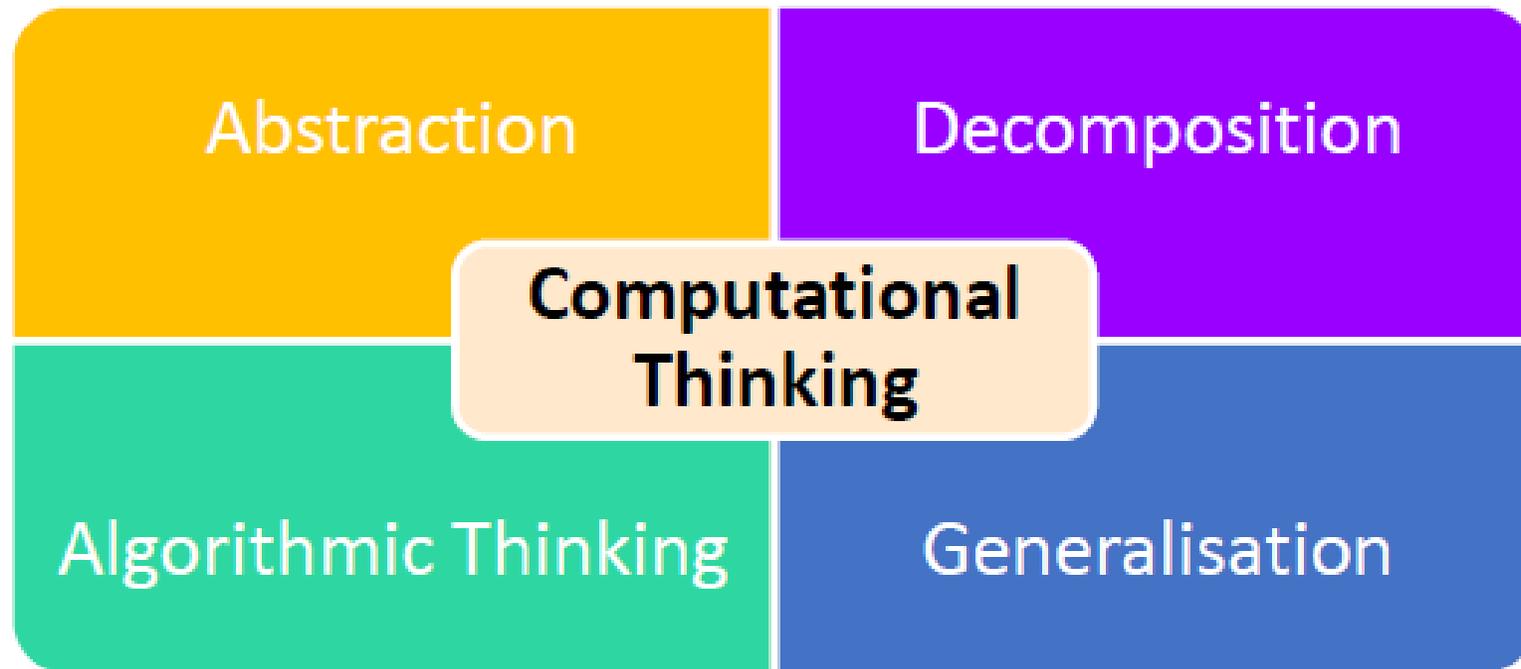
PM Lee Hsien Loong posts source code for sudoku solver. Experts give their take

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Computational Thinking

- Computational thinking is parked under mathematics



Four Skills in Computational Thinking

Computational Thinking



The four steps of abstraction, decomposition, algorithmic thinking and generalization are akin to the four steps of Polya's problem-solving model.



Abstraction – provides students with more authentic problems with the opportunity to formulate the problems using mathematical representation (c.f. Understand the Problem of Polya)



Decomposition – provide students with problems without scaffolding for them to think of intermediate steps and sub-problems (c.f. Heuristics in Devise a Plan of Polya)

Computational Thinking



Algorithmic Thinking – provide students with opportunities to write out or summarise the steps of mathematical procedures using a flowchart, decision tree or code (c.f. Devise a Plan of Polya)



Generalization – provide students with more opportunities to derive general methods based on specific cases, such as during the introduction of a new concept or learning a new mathematical procedure.(c.f. Check and Expand stage of Polya)

Computational Thinking

- Use of spreadsheet (Microsoft Excel) is a common feature found in the local mathematics textbooks.
- For the more able students, coding is introduced.
- Close collaboration between School Teachers and Mathematics Educators in *infusing* computational thinking into regular mathematics curriculum.

Data Science

- Data Science is not yet an independent subject in the school mathematics curriculum.
- In the mathematics curriculum, there is an increased emphasis on data handling: both data representation and data interpretation, looking for trends and making predictions based on data.
- Likely move would be a revamp of the Secondary School Statistics strand within the school mathematics curriculum.



Integration of the Learning Resource

Student Learning Space

- The Student Learning Space (SLS) is a “one-stop” platform for students’ learning. It is a response to the EdTech Masterplan 2030.
- All the AI tools are found within the SLS.



The screenshot shows the top navigation bar of the Student Learning Space website. The navigation menu includes: [Student Learning Space](#), [NOTICES](#) (with a dropdown arrow), [TEACHERS](#) (with a dropdown arrow), [STUDENTS](#) (with a dropdown arrow), [PARTNERS](#) (with a dropdown arrow), and [ABOUT](#) (with a dropdown arrow). Below the navigation bar is a dark blue banner with the breadcrumb trail: [HOME](#) / [ABOUT REVISED](#) / [OVERVIEW OF SLS](#) / [SLS AS A KEY ENABLER OF EDTECH...](#). The main heading of the banner is **SLS as a key enabler of EdTech Masterplan 2030**. Below the banner, there are two columns of content. The left column has a link [Overview of SLS](#) with an upward arrow and a thumbnail image with the text [SLS as a key enabler of EdTech Masterplan](#) and a URL <https://www.learning.moe.edu.sg>. The right column has a link [Supporting EdTech Masterplan 2030](#) and a paragraph of text: "The Transforming Education through Technology Masterplan 2030 (or EdTech Masterplan 2030) provides direction on how MOE will do more to:".

Teacher Education and Professional Development

Teacher Education and Professional Development

There are teacher professional practices in the teacher education program which gain importance in the AI era.

- An example: the design of MCQ in mathematics to identify student misconceptions → Alternative Conception Framework
- Sequencing of MCQs to check mastery or lack of mastery of a particular concept



Teacher Education and Professional Development

Teacher Education and Professional Development

There are aspects of teacher education which are modified in the AI era.

- Design of a lesson plan → Critique of a lesson plan, enactment of the lesson and revision of the lesson plan.
- Provide appropriate prompts versus starting from scratch.



Teacher Education and Professional Development

Mathematics Teacher Education

- In the Singapore National Institute of Education, the Bachelor Degree of mathematics is now named as Mathematics & Computational Thinking.
- Student teachers are exposed to Digital Literacy in the form of coding; Computational Mathematics is one compulsory module; CT is infused into the teaching of Pure Mathematics.
- Curriculum Studies courses involve exposing students to CT under educational technology segment.

Teacher Education and Professional Development

Mathematics Teacher Education

- In the National Institute of Education, the statistics component for mathematics teacher education has gained importance. The recent revision of the mathematics content ensures **ALL** mathematics pre-service teachers learn statistics starting from the first year.
- Data Science is introduced as one of the core courses in the **Master of Science (Mathematics for Educators)** course.



Current Challenges

- Will AI take away the learning of the students?
 - Learning about AI
 - Learning from AI
 - Learning with AI
 - Learning beyond AI
- Teachers are not familiar with the use of spreadsheets.
 - Challenging to convince them to do coding.
- Teachers need to be familiar with mathematical reasoning, especially with open-ended questions.