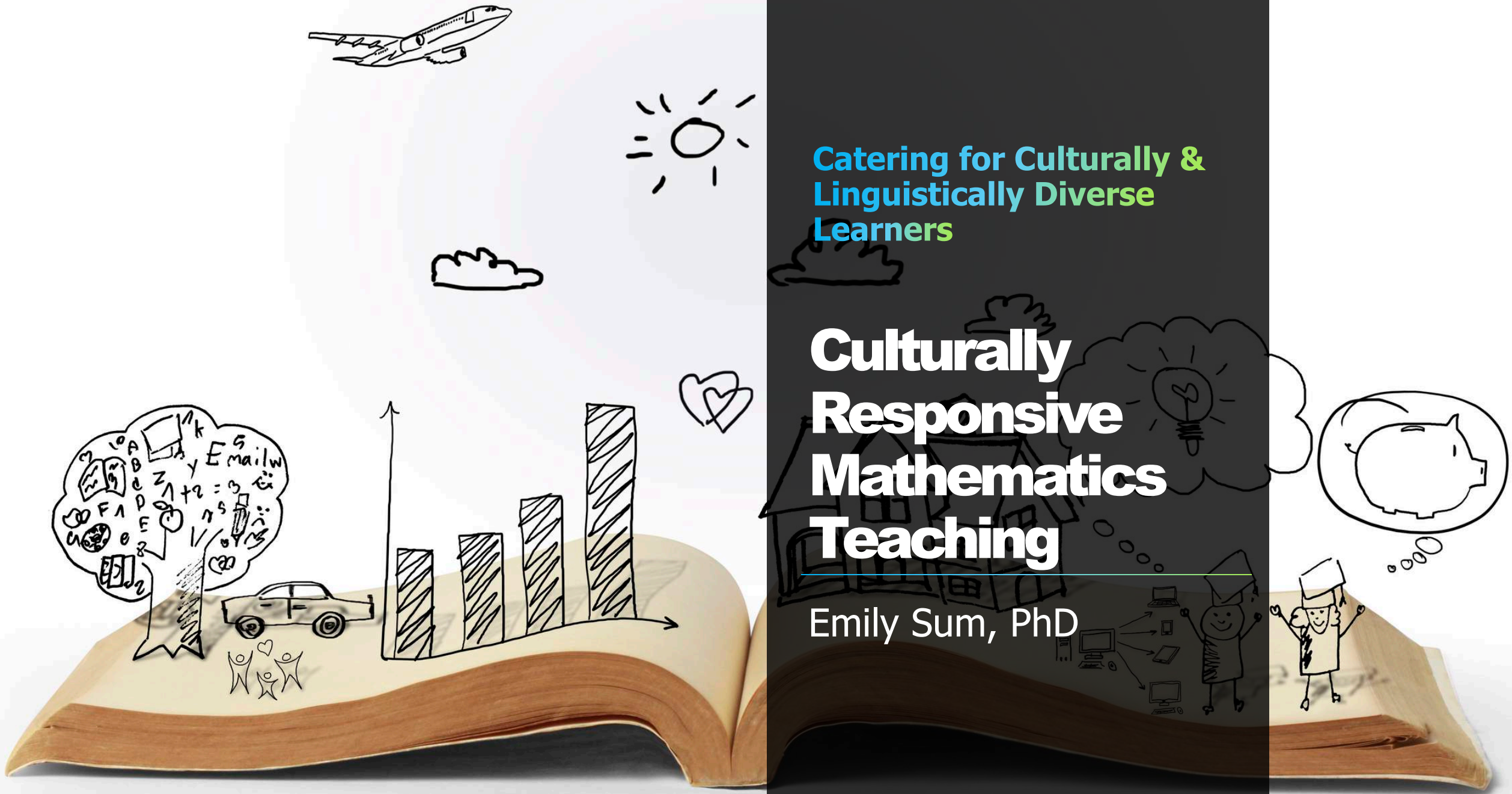
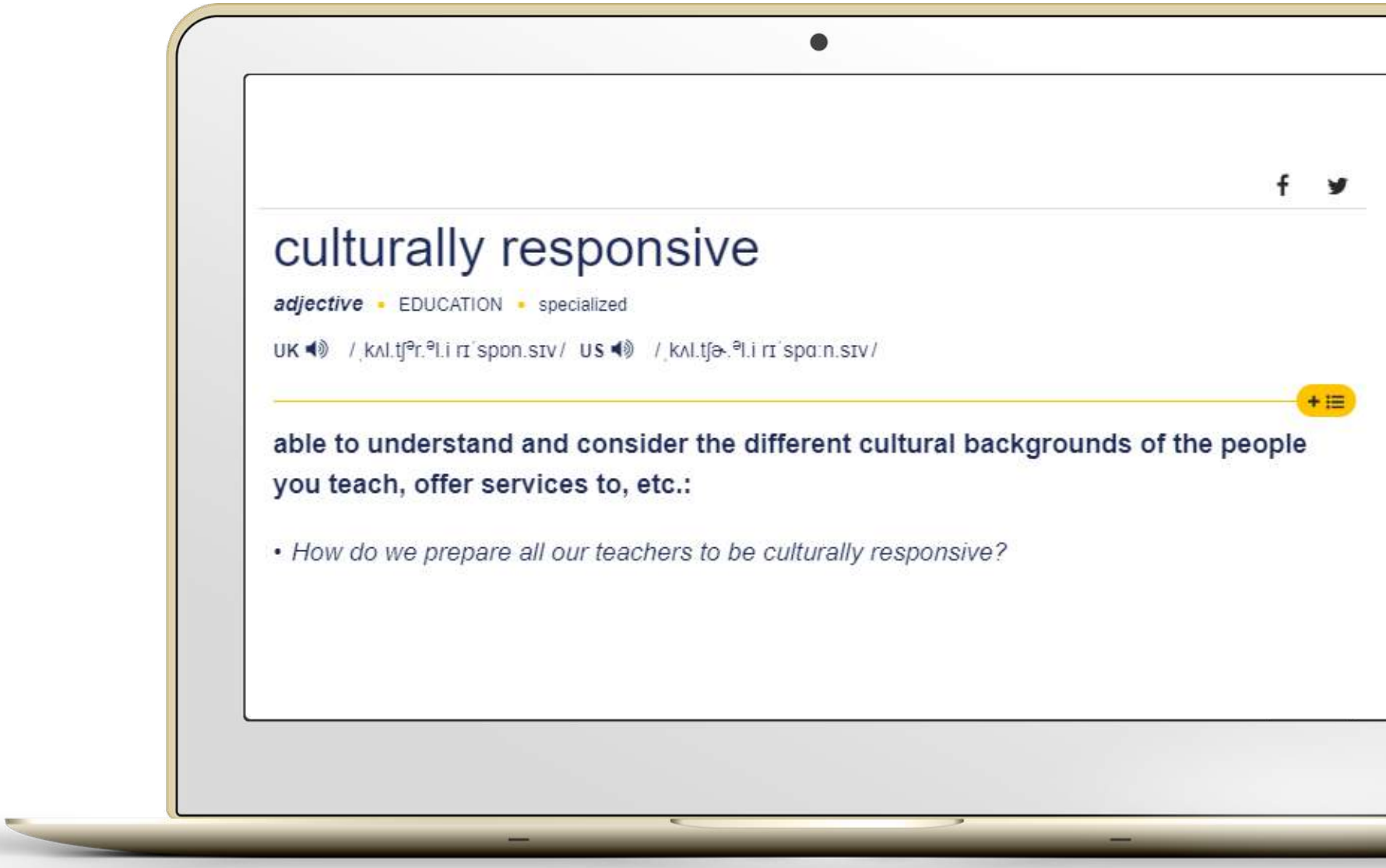


Catering for Culturally & Linguistically Diverse Learners

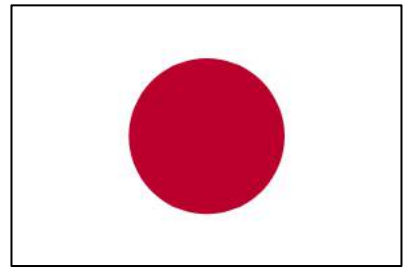
Culturally Responsive Mathematics Teaching

Emily Sum, PhD

What Does Culturally Responsive Mean?



What Does Culturally Responsive Mean?

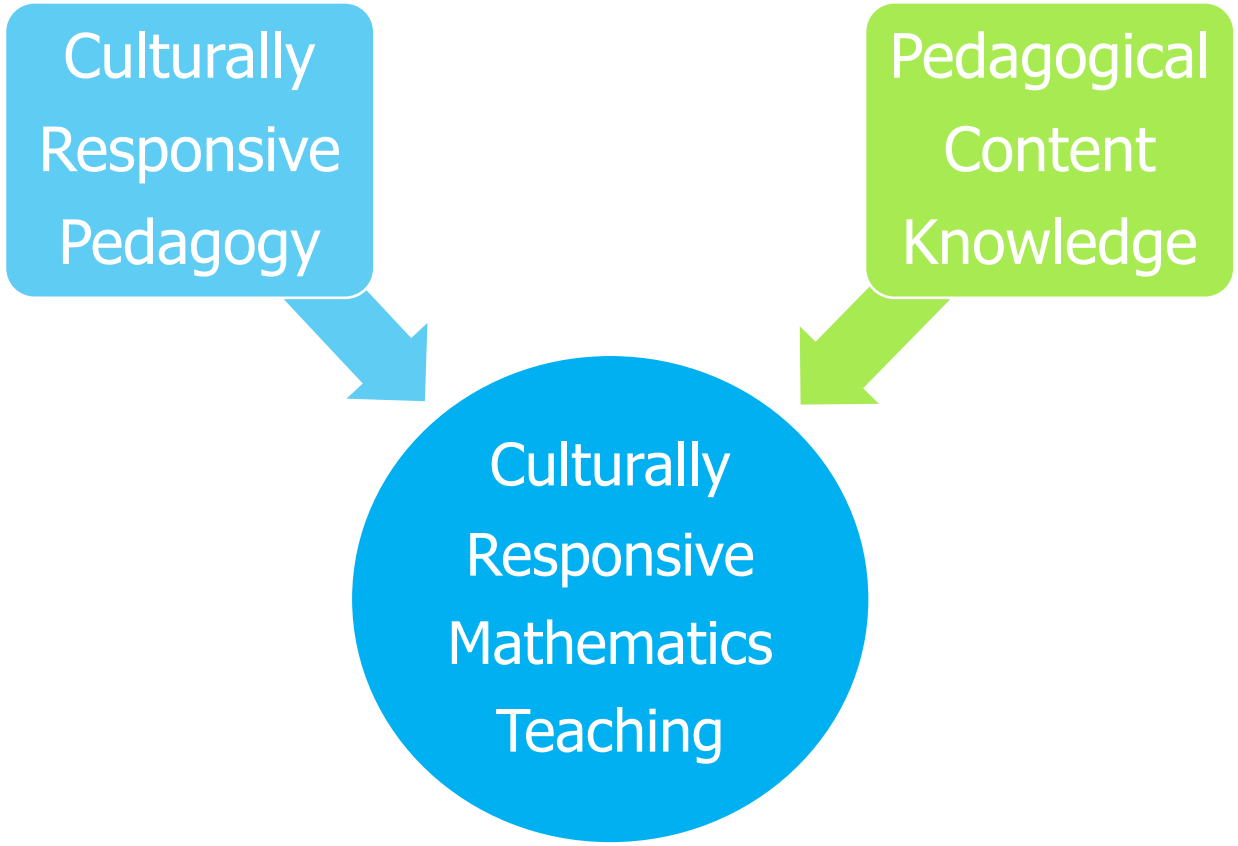


朱子《童蒙須知》〈雜細事宜〉提到：「凡飲食，舉匙必置箸，舉箸必置匙，食已，則置匙箸於案。」

Culturally Responsive Teaching (CRT)

Gay (2002, 2010); Ladson-Billings (1994)

- Defined as "*using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively*" (Gay, 2002, p. 106).
- The pedagogical framework recognizes and affirms
  - the diverse cultural backgrounds and experiences students bring to the classroom; and
  - the importance of including students' cultural references in all aspects of learning.



Developing CRMT

Attending to students' funds of knowledge (FoK)

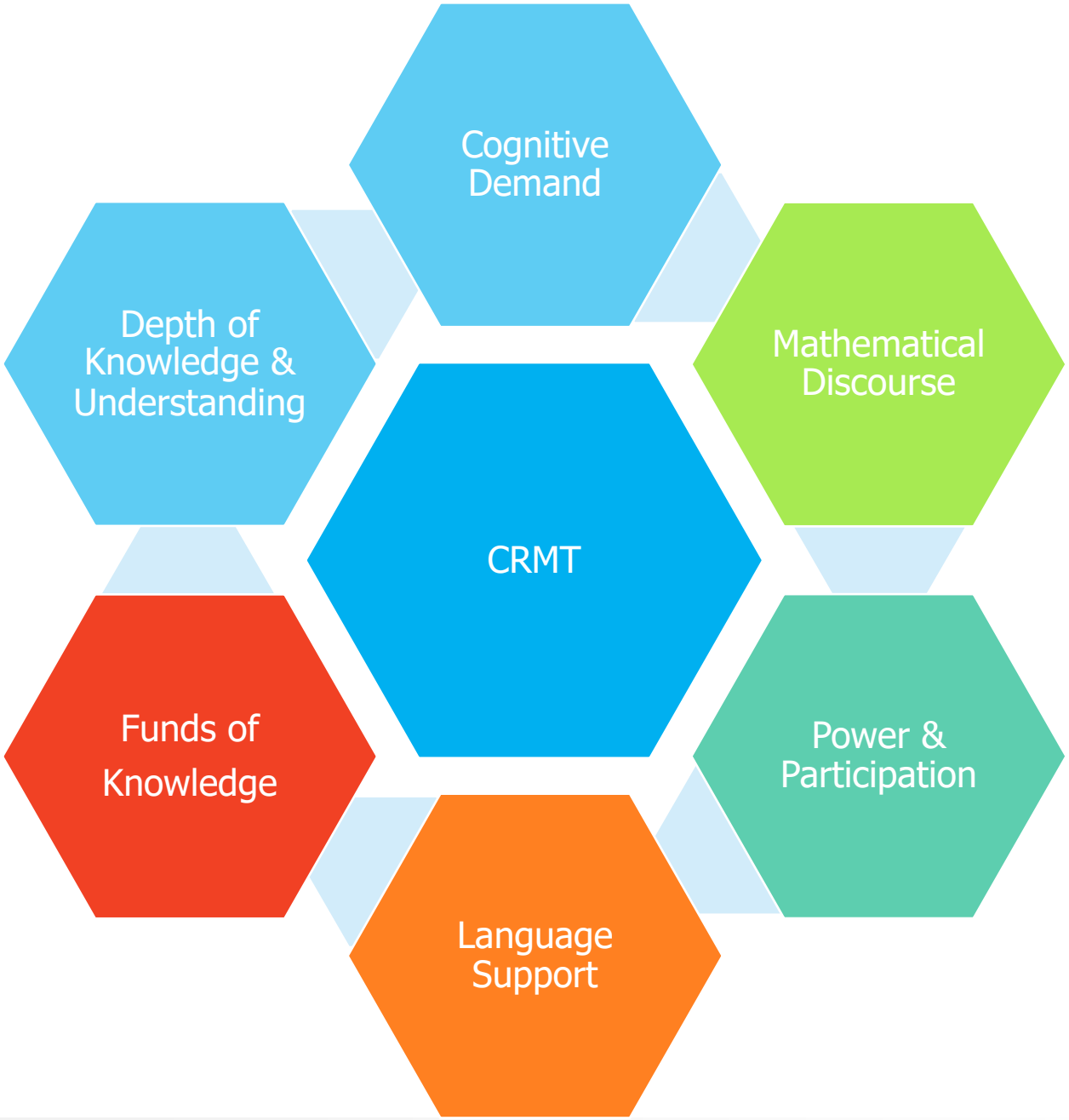
- Learning is a complex, non-linear, and meaning-making process based on prior knowledge and experience.
- Teaching involves bridge building between previous knowledge and new knowledge (Lampert, 2001).
- Teachers must develop a socio-cultural political consciousness.
- Students construct their knowledge through social interaction that is mediated by language and culture (Cobb & Bowers, 1999).
- "*CRMT involves a set of specific pedagogical knowledge, dispositions, and practices that privilege mathematical thinking, cultural and linguistic Funds of Knowledge (FoK), and issues of power and social justice in mathematics education*" (Aguirre & del Rosario Zavala, 2013, p.167).

CRMT Frameworks

Comparisons (I, Chang, Son, 2019)

	Aguirre and del Rosario Zavala (2013)	TEACH MATH (2012)	Category
1	Intellectual support	Cognitive demand	Mathematical thinking
2	Depth of student knowledge & understanding	Depth of student knowledge & understanding	
3	Mathematical analysis		
4	Mathematical discourse & communication	Mathematical discourse & communication	
5	Student engagement	Power & participation	Empowerment
6	a) Academic language support for ELL-use of L1	Academic language support	Language
	b) Use of ESL scaffolding strategies		
7	Funds of knowledge/ culture/ community support	Funds of knowledge/ culture/ community support	Culture
8	Use of critical knowledge/ social justice	Use of critical knowledge/ social justice	Social justice

Conceptual Framework



Cognitive Demand

Smith & Stein (1998)

Levels of Cognitive Demands

Memorization | Procedures without connections | Procedures with connections | Doing mathematics

Lower-level demands

Reproduction; no meaning-making;
focus on correct answer;
no explanation; no ambiguity;
no connections to concepts

Higher-level demands

Meaning-making; understanding why;
close connections to underlying concepts;
multiple ways/representations;
high analysis; high ambiguity;
requires complex thinking and explanation

Depth of Knowledge and Understanding

Carpenter & Fennema (1989; 1996); Turner et al. (2009)

- Cognitively Guided Instruction (CGI): Understand children's thinking/ reasoning and use this knowledge to make instructional decisions.
- Adapted instructional methodologies (materials) to include students' understanding.
- Activities integrate multiple knowledge bases, e.g. mathematical concepts and skills, community knowledge and experiences, and critical understandings about the world, via problem-posing-solving pedagogy.
- Draw on multiple knowledge bases (including multiple representations) to support students' learning and their capacity to critically engage with situations in their lives.

Depth of Knowledge and Understanding

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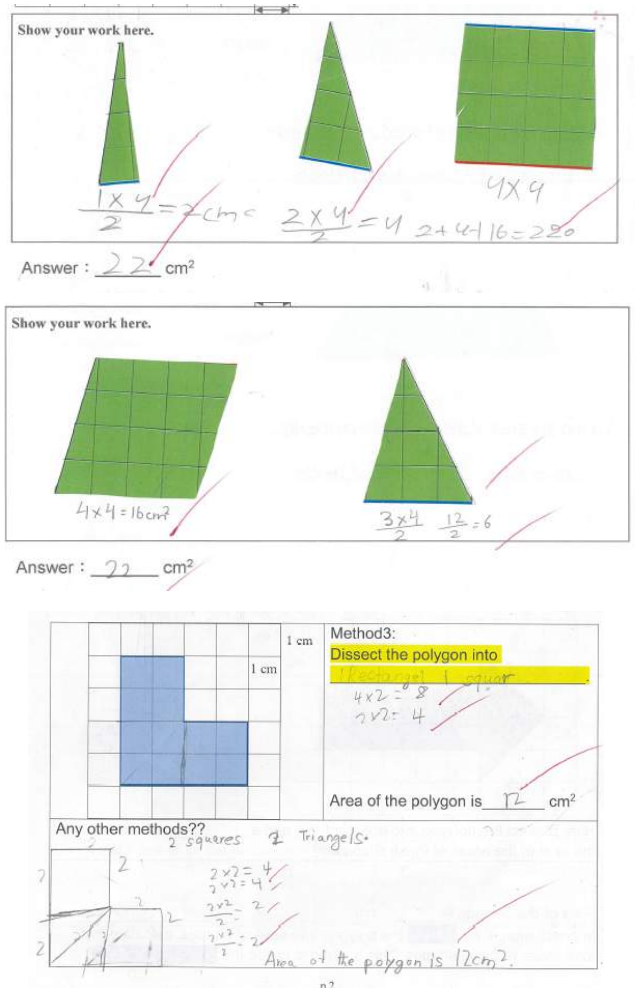
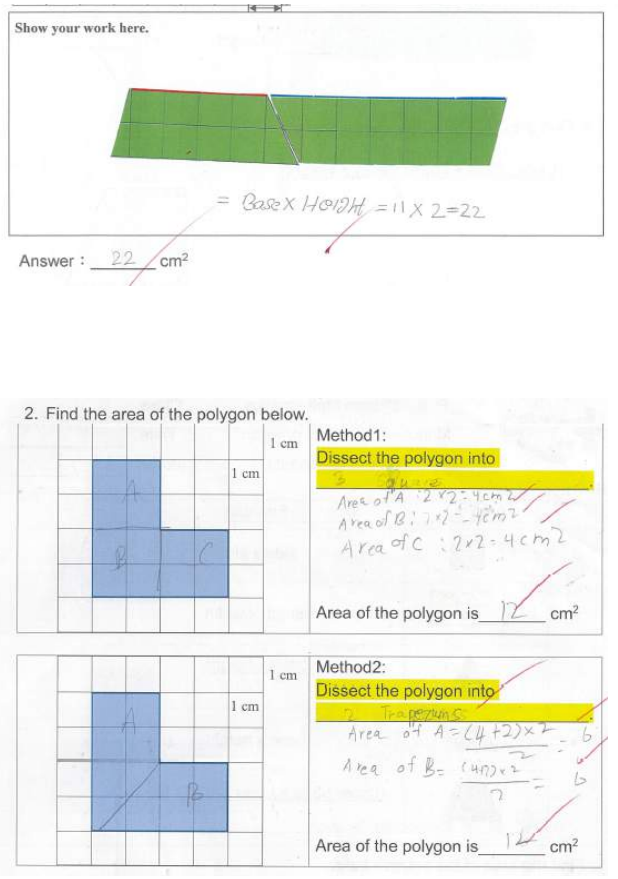
- Gradually increased the level of cognitive demand to deepen students' knowledge and understanding – First started with exploring and finding the area of the right-angled triangle, and then had students to cut trapeziums, parallelograms and polygons into several triangles.
- Used visual representations to make students' understanding visible. Most students were engaged and able to demonstrate their understanding.





Mathematical Discourse

Moschkovich (1999; 2002; 2010)

- Based on sociocultural and situated views of both language and mathematics learning.
- Use student's home culture and language as resources rather than treated as deficits within mathematical instruction.
- Encouraging students to explain details of their problem-solving and the reasoning processes.

Focuses:

1. Acquisition of vocabulary
2. Construction of multiple meanings across registers, the meanings that belong to the language of mathematics. For example, "prime number," "prime time," or "prime rib." and the word "more".
3. Participating in meaningful and rigorous mathematical discussions.

Mathematical Discourse

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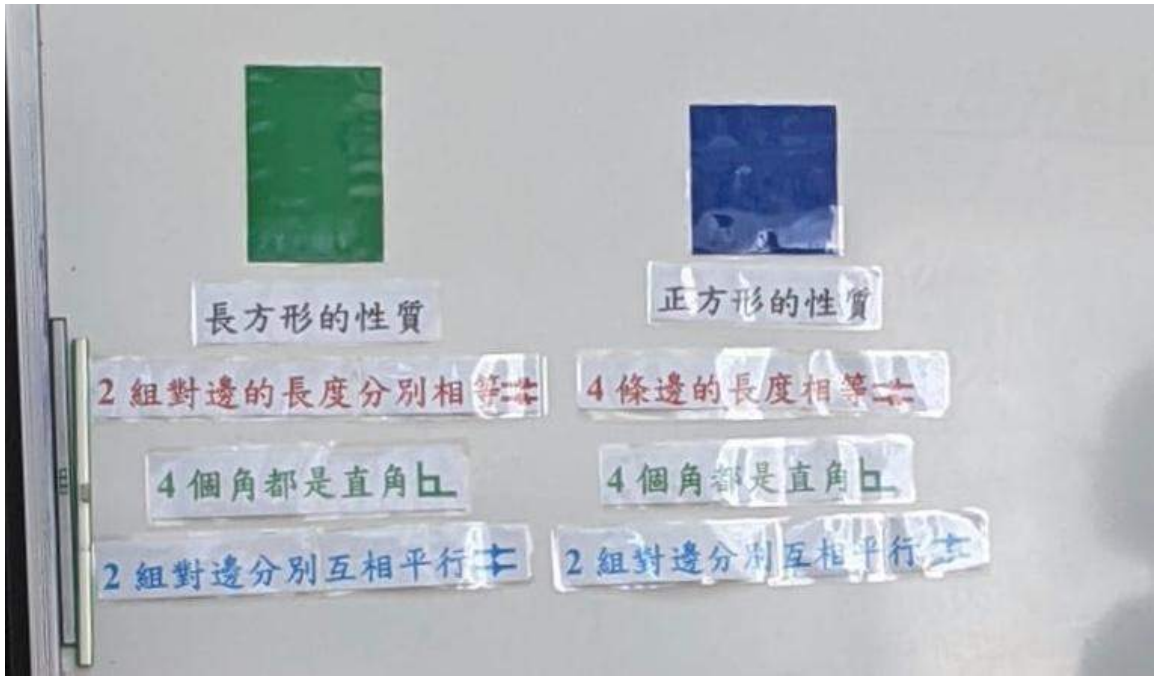
- Cheng Sir's lessons focused on comparing the properties of quadrilaterals through whole-class discussion. He provided students with questions (as well as sentence frames) to stimulate their discussion and engagement.
  - Acquiring vocabulary
  - Constructing meanings
  - Participating in discourses



Language Support

Chval and Chavez (2011); Chval and Khisty (2009)

- Connecting language with mathematical representations (e.g., pictures, tables, graphs, and equations) and use visual supports such as concrete objects, videos, illustrations, and gestures in classroom conversations.
- Discussing examples of students' mathematical writing and provide opportunities for students to revise their writing.

- Using NLS as an example, NCS students required time for Chinese language development, a time when they learn sentence frames/ structures, additional vocabulary and how Chinese is used in mathematics classrooms.

Language Support

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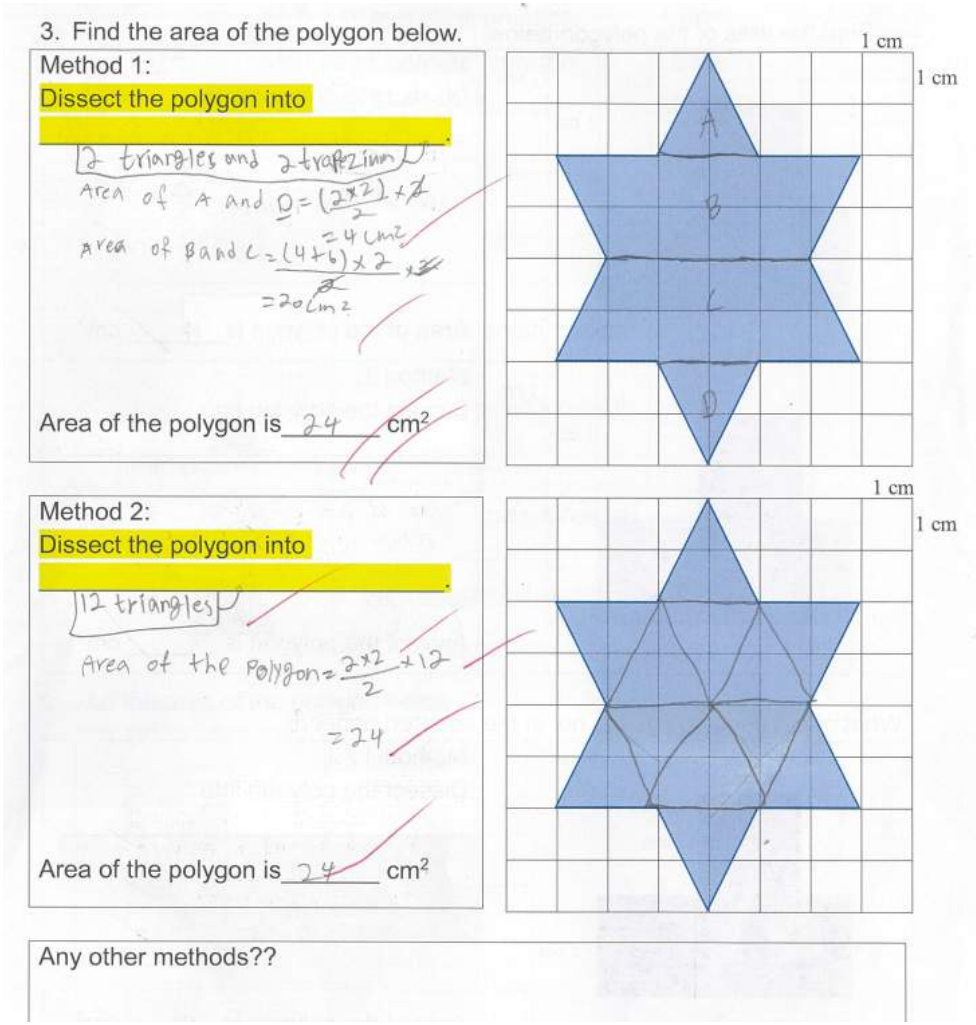
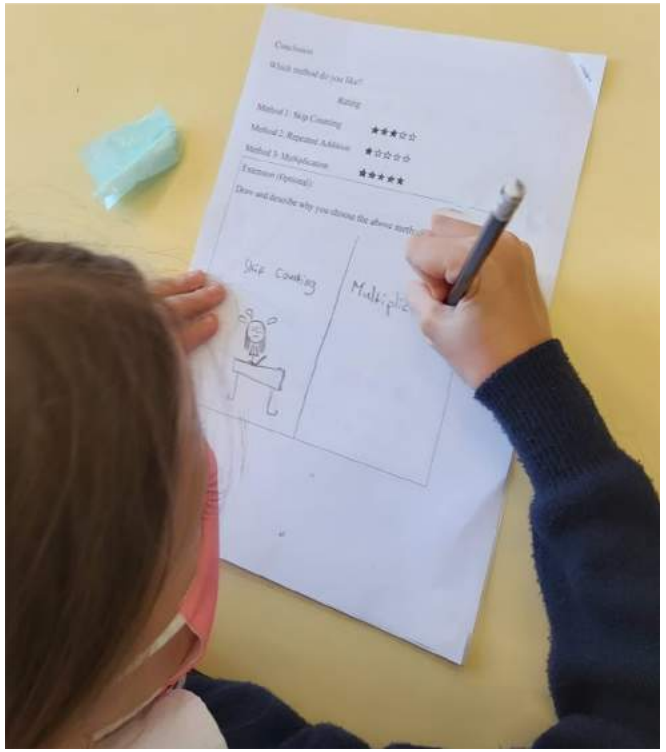


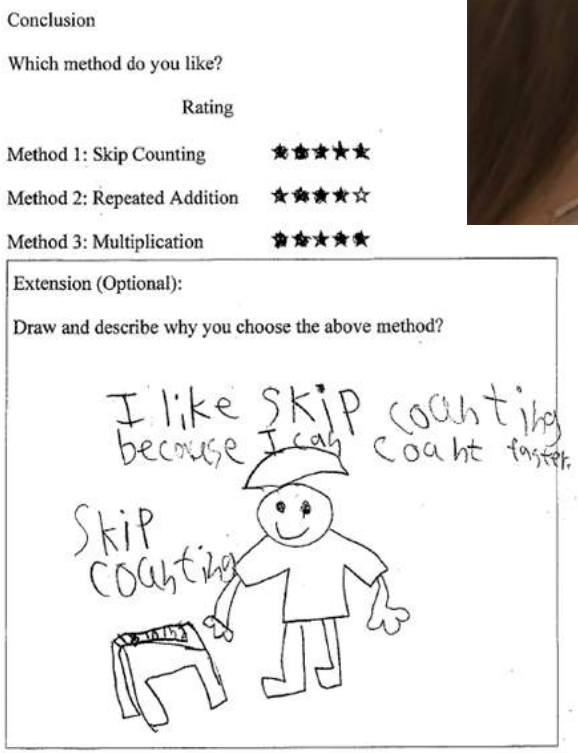
- Both 黃偉傑主任 and 李常樂主任 expressed students' difficulties in understanding the concepts and some NCS students cannot speak nor write English.
- Various language support-based strategies to develop mathematical discourse and meaning-making would be useful. For example;
  - Use everyday language, such as cut instead of dissect;
  - Include language objectives as well as mathematics objectives, such as parallel, parallel imports (水貨);
  - Use choral response to have students practice the vocabulary and sentences;
  - Revoicing … and many more.

Power and Participation

Featherstone et al. (2011)

- Delegate/ distributes mathematical knowledge authority to students – teacher positions CLDs as successful contributors of the learning community.
- Values and respects students mathematical contributions.
- Addresses status differences among students (Local vs Language learners).





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Power and Participation

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- Venn diagram was used to consolidate student's contribution and to show the inclusion relations among quadrilaterals.
- Student's contribution was valued and respected by the teacher. The authority of mathematical knowledge in Cheng Sir's class was widely shared between him and the students.

Cultural [Community-based] Funds of Knowledge

Civil (2007); Civil & Kahn (2001); Turner et al. (2012)

- Teachers need to shift their view from abstract mathematics to humanized and relevance mathematics (Boaler 2016; Gutiérrez 2018).
- Incorporate the mathematical knowledge and practices embedded in daily household and out-of-school activities of families and communities.
- FoK approaches to teaching mathematics demonstrate how family activities such as gardening, sewing, scheduling, cooking, and playing games are mathematical resources available to students and teachers to support mathematics learning.

https://www.isseymiyake.com/en/news/6129

Guiding Questions

Modified/Proposed CRMT Unit Planning OR Lesson Observation & Analysis TOOL (Aguirre & del Rosario Zavala, 2013).

Cognitive Demand

- How does my lesson enable students to explore and analyse mathematical concepts(s), procedure(s), and reasoning strategies?
- Does it utilize multiple representations, and demand explanation or justification?

Depth of Knowledge & Understanding

- How does my lesson make student thinking/ understanding more visible and deeper?

Mathematical Discourse

- How does my lesson create opportunities to discuss math in meaningful and rigorous ways?
  - debate math ideas/ solution strategies,
  - use math terminology, develop explanations
  - communicate reasoning, and make generalizations

Guiding Questions

Modified/Proposed CRMT Unit Planning OR Lesson Observation & Analysis TOOL (Aguirre & del Rosario Zavala, 2013).

Language Support	Power & Participation	[Culture] Funds of Knowledge
• How does my lesson provide academic language support for Chinese/ English language learners?	• How does my lesson distribute maths knowledge authority, value student maths contributions, and address status differences among students?	• How does my lesson help students connect mathematics with relevant/ authentic situations in their lives and communities?

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Thank You