A TRADITION OF INDEPENDENT THINKING

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Working with emergent plurilingual learners in numeracy instruction

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What we'll cover...

Fundamental principles when working with emergent plurilingual students.

What is a language repertoire and how do I support it? What are funds of knowledge?

Language proficiency, CALPS and mathematical discourse

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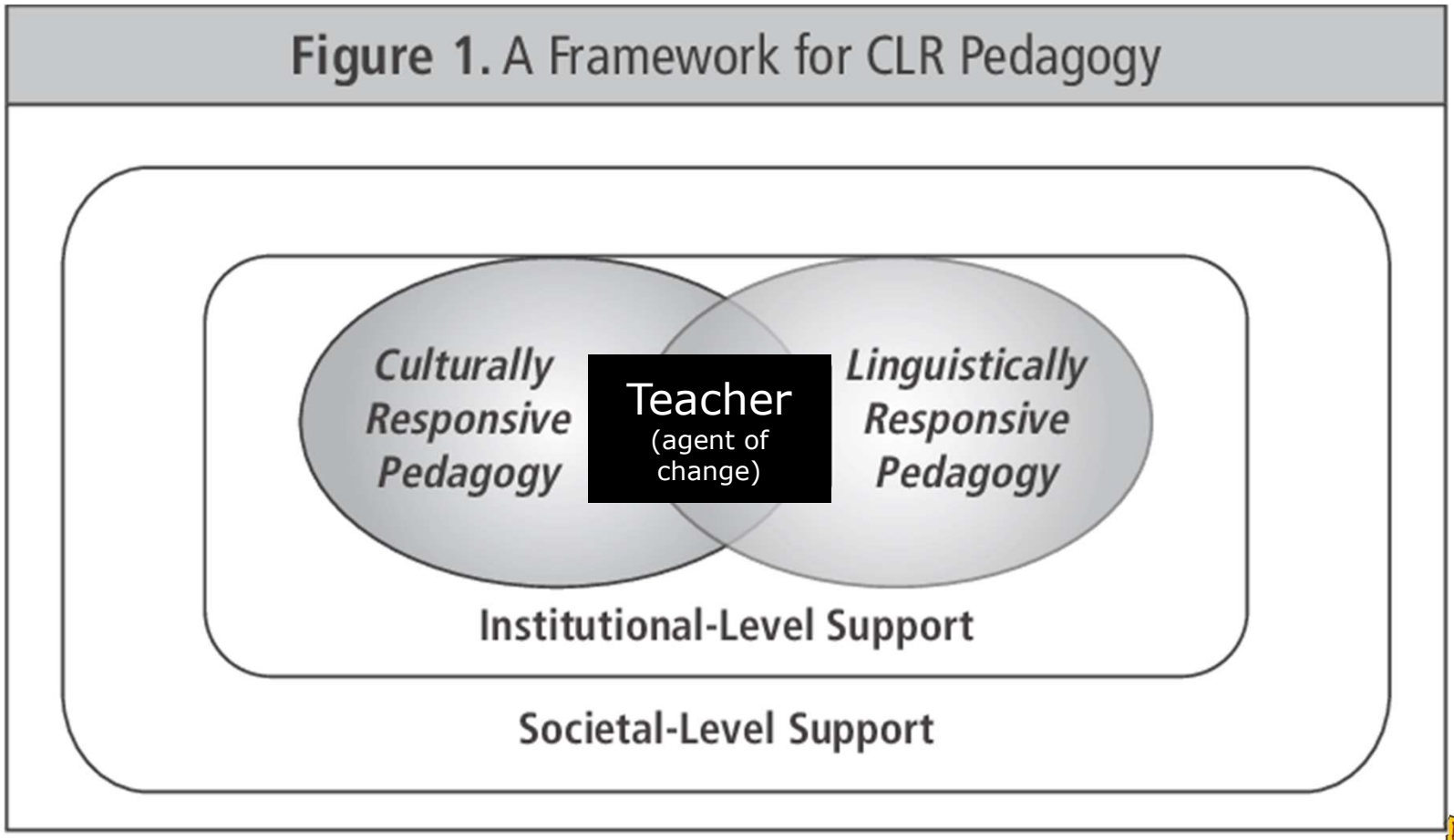
Pedagogical approach



Zhang-Wu, 2017: CLR

Pedagogical approach

'Every teacher is a languages teacher.'

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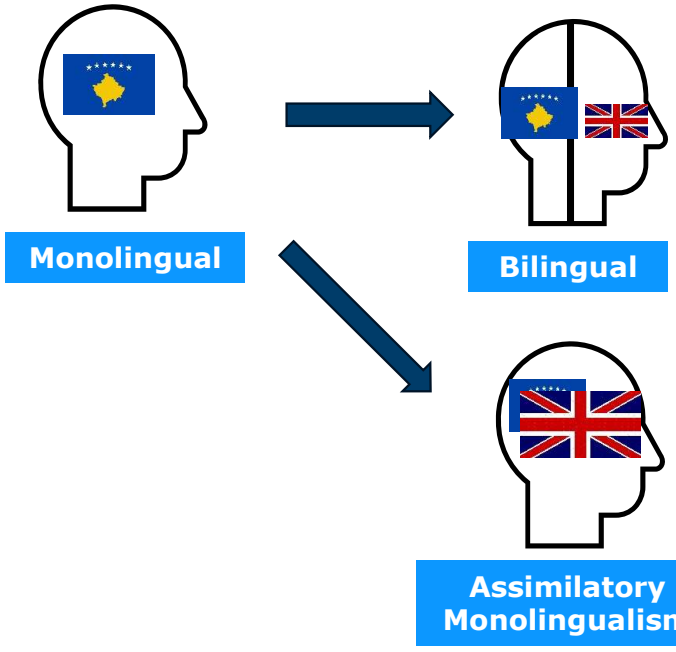
Communication is fundamental to learning.

What does it mean to be plurilingual?

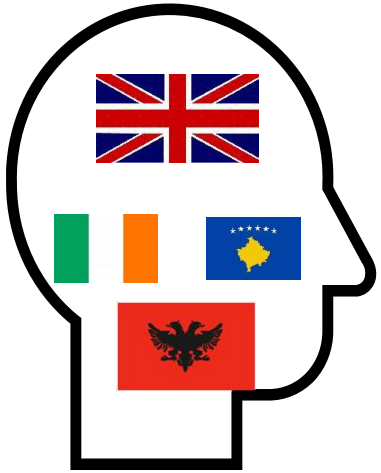
Multilingual mindset



Value-added Approach

Deficit Approach

Plurilingual mindset



Funds of Knowledge
Strategies and bodies of knowledge accumulated in homes and communities [which allow pupils] to participate with people they trust
(González et al, 2005, pg 91-92)

What is a language repertoire and how do I support it?

Language Repertoire

A set of various linguistic identities and associated codes, which one person can use in different situations.

(Finegan, 2014, p. 547).

We must **foster** the linguistic repertoires of all our students because their competence in one language will support their competence in other languages that they acquire as well as reaffirming their (pluri)linguistic and (pluri)cultural identity.

What is language proficiency?

Language Proficiency

Basic Interpersonal Communicative Skills (BICS)		Cognitive Academic Language Proficiency (CALPS)	
Basic language system used in face-to-face communication	Proficiency only weakly correlated with academic success	Formal and academic registers, high levels of literacy, specialised vocab	Strongly correlated to academic success

Cummins, 2000

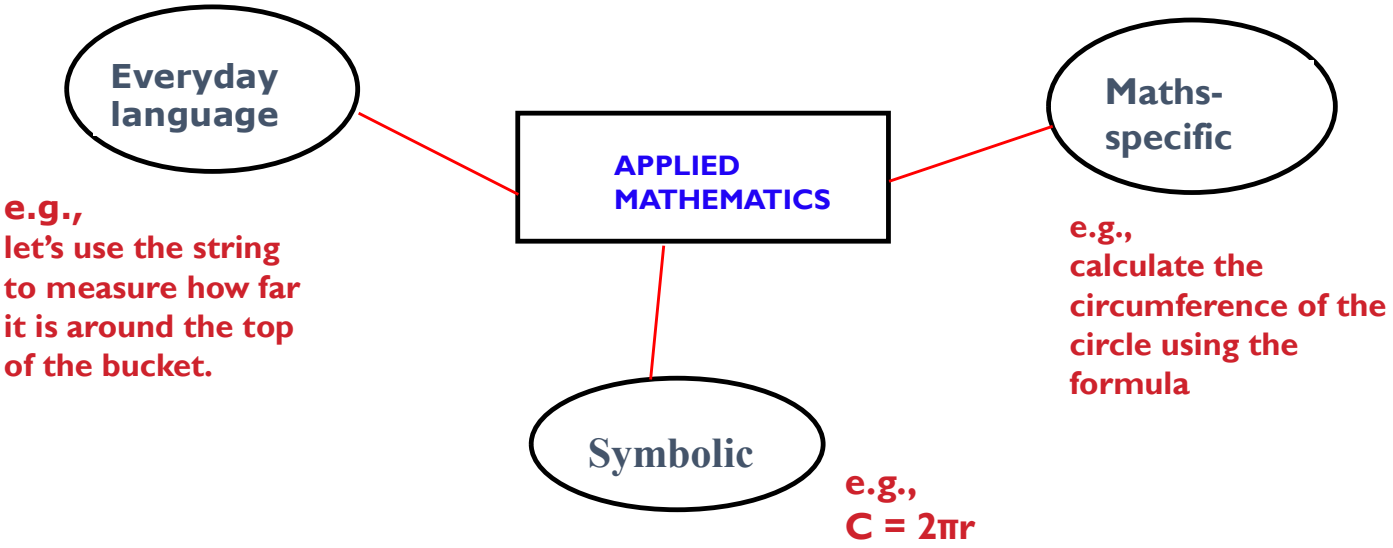
The Mathematics Register

We consider mathematical language as a distinct **'register'** within a natural language e.g. English or Irish.

Which is described as ***"a set of meanings that is appropriate to a particular function of language, together with the words and structures which express these meanings."*** *(Halliday 1975, p.65).*

The Mathematics Register

Within the mathematics register different forms of mathematical language can be found.



(Meaney, 2005)

The Mathematics Register

This reinforces the view that the content of mathematics is **not taught without language**.

The process of learning mathematics involves the **mastery** of the mathematics register.

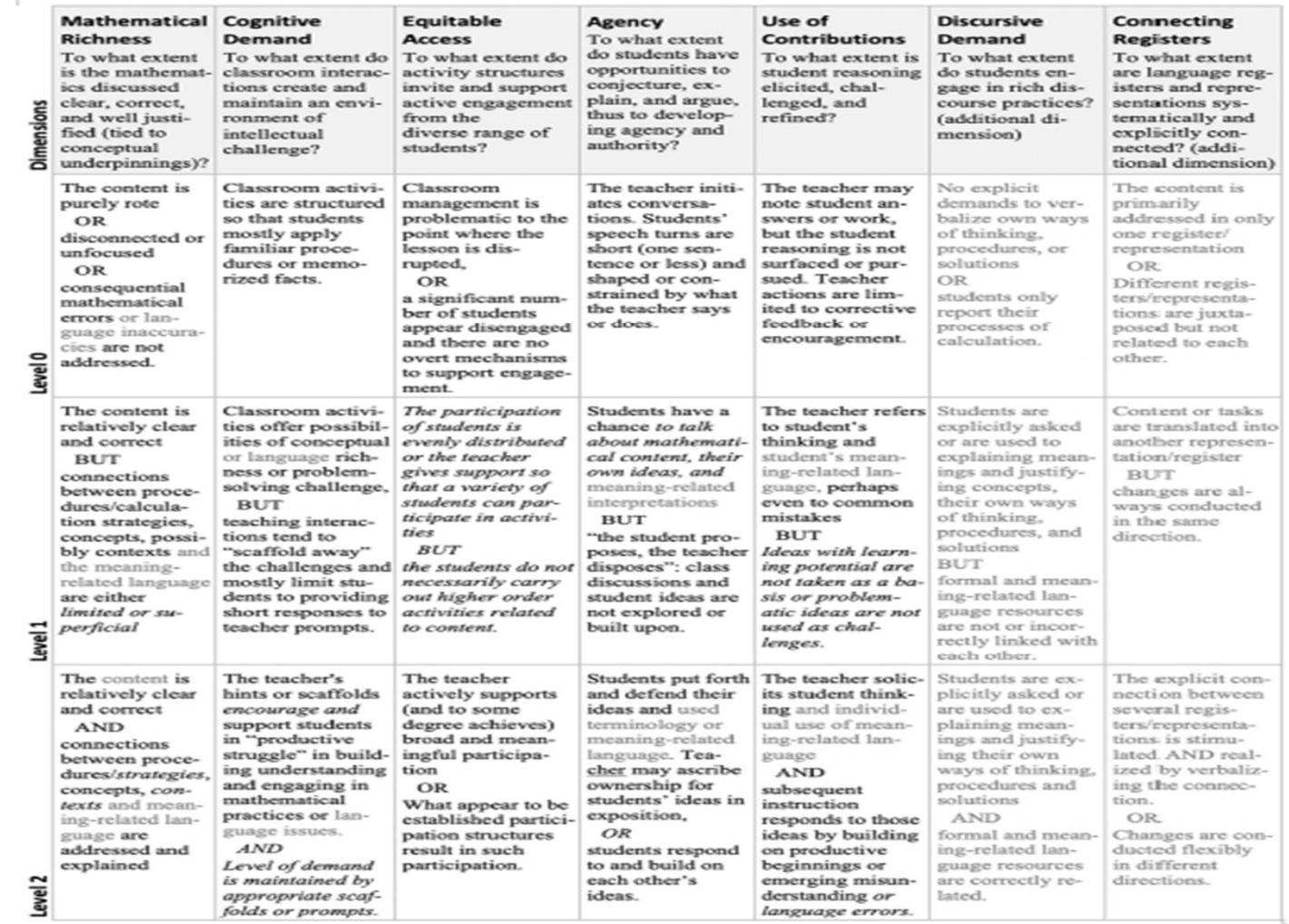
This allows students to communicate their mathematical findings in a suitable manner but **without this fluency**, students are **restricted** in the ways that they can develop or redefine their mathematical understandings.

(Meaney, 2005)

Major Design Principles (Erath et al., 2021)

For language learning to be a catalyst for mathematics learning, materials and instruction should:

- Engage students in rich discourse practices
- Establish various mathematics language routines
- Connect language varieties and multimodal representations
- Include students' multilingual resources
- Use macro-scaffolding to sequence and combine language and mathematics learning opportunities,
- Compare language pieces (form, function, etc.) to raise students' language awareness.



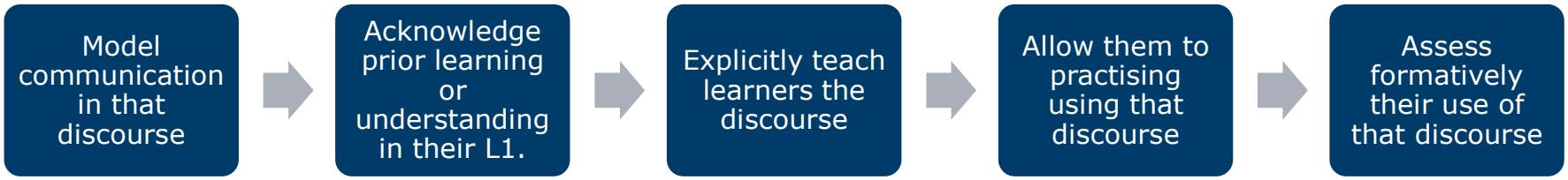
Dimensions	Mathematical Richness To what extent is the mathematics discussed clear, correct, and well justified (tied to conceptual underpinnings)?	Cognitive Demand To what extent do classroom interactions create and maintain an environment of intellectual challenge?	Equitable Access To what extent do activity structures invite and support active engagement from the diverse range of students?	Agency To what extent do students have opportunities to conjecture, explain, and argue, thus to developing agency and authority?	Use of Contributions To what extent is student reasoning elicited, challenged, and refined?	Discursive Demand To what extent do students engage in rich discourse practices? (additional dimension)	Connecting Registers To what extent are language registers and representations systematically and explicitly connected? (additional dimension)
Level 0	The content is purely rote OR disconnected or unfocused OR consequential mathematical errors or language inaccuracies are not addressed.	Classroom activities are structured so that students mostly apply familiar procedures or memorized facts.	Classroom management is problematic to the point where the lesson is disrupted, OR a significant number of students appear disengaged and there are no overt mechanisms to support engagement.	The teacher initiates conversations. Students' speech turns are short (one sentence or less) and shaped or constrained by what the teacher says or does.	The teacher may note student answers or work, but the student reasoning is not surfaced or pursued. Teacher actions are limited to corrective feedback or encouragement.	No explicit demands to verbalize own ways of thinking, procedures, or solutions OR students only report their processes of calculation.	The content is primarily addressed in only one register/representation OR Different registers/representations are juxtaposed but not related to each other.
Level 1	The content is relatively clear and correct BUT connections between procedures/calculation strategies, concepts, possibly contexts and the meaning-related language are either *limited or superficial*	Classroom activities offer possibilities of conceptual or language richness or problem-solving challenge, BUT teaching interactions tend to "scaffold away" the challenges and mostly limit students to providing short responses to teacher prompts.	*The participation of students is evenly distributed or the teacher gives support so that a variety of students can participate in activities* *BUT* *the students do not necessarily carry out higher order activities related to content.*	Students have a chance *to talk about mathematical content, their own ideas, and* meaning-related interpretations BUT "the student proposes, the teacher disposes": class discussions and student ideas are not explored or built upon.	The teacher refers to student's thinking and student's meaning-related language, perhaps even to common mistakes BUT *Ideas with learning potential are not taken as a basis or problematic ideas are not used as challenges.*	Students are explicitly asked or are used to explaining meanings and justifying concepts, their own ways of thinking, procedures, and solutions BUT formal and meaning-related language resources are not or incorrectly linked with each other.	Content or tasks are translated into another representation/register BUT changes are always conducted in the same direction.
Level 2	The content is relatively clear and correct AND connections between procedures/*strategies*, concepts, *contexts* and meaning-related language are addressed and explained	The teacher's hints or scaffolds *encourage and* support students in "productive struggle" in building understanding and engaging in mathematical practices or language issues. *AND* *Level of demand is maintained by appropriate scaffolds or prompts.*	The teacher actively supports (and to some degree achieves) broad and meaningful participation OR What appear to be established participation structures result in such participation.	Students put forth and defend their ideas and used terminology or meaning-related language. Teacher may ascribe ownership for students' ideas in exposition, *OR* students respond to and build on each other's ideas.	The teacher solicits student thinking and individual use of meaning-related language AND subsequent instruction responds to those ideas by building on productive beginnings or emerging misunderstanding *or language errors.*	Students are explicitly asked or are used to explaining meanings and justifying their own ways of thinking, procedures and solutions AND formal and meaning-related language resources are correctly related.	The explicit connection between several registers/representations is stimulated AND realized by verbalizing the connection. OR Changes are conducted flexibly in different directions.

Fig. 2 L-TRU framework: language-responsive mathematics teaching for robust understanding (Adaptations from Schoenfeld's TRU (2013) are marked in grey if they concern language and in *italics* if they were necessary to capture relevant differences in our data set more closely)

Prediger, S. & Neugebauer, P. (2021). Capturing teaching practices in language-responsive mathematics classrooms Extending the TRU framework "teaching for robust understanding" to L-TRU. *ZDM-Mathematics Education*, **53**, 289-304, https://doi.org/10.1007/s11858-020-01187-1

How do we develop CALPS whilst being linguistically and culturally responsive ?

- For acquisition of mathematical discourse, the goal of numeracy educators is to provide **comprehensible linguistic input to learners by integrating it with content:**



- Numeracy educators should ensure that '**social interactions**' form the basis of communication in numeracy lessons. This is how language is best acquired.
- Numeracy educators should assess **prior knowledge** through their **L1**, including acknowledging alternative methodologies for notation.
- Numeracy educators must foster a **safe and secure** learning environment.

How do we develop CALPS whilst being linguistically and culturally responsive ?

7 x 2 = ___

Prior to any lesson, analyse the discourse of your chosen lesson for:

Key concepts	Verbs in communicative forms	Connectors	Sequencing Words	Asking questions
Mutiplication	Multiplied by…is/equals Times by…is/equals 'seven twos' are	And Also But	Firstly, Then, Next, Step 1/2/3 Finally	What is_____multiplied by?

How do we develop CALPS whilst being linguistically and culturally responsive ?

7 x 2 = ___

Can you explain to me in Spanish what 7 x 2 equals? Write as you say it.

Sí, siete por dos son catorce.

Be consistent

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How do we develop CALPS whilst being linguistically and culturally responsive ?

$$7 \times 2 = 14$$

Seven	Multiplied by	Two	Equals	fourteen

So in English, we express this as seven multiplied by two equals fourteen. Can you repeat that for me?

Seven multiplied by two is fourteen.

How do we develop CALPS whilst being linguistically and culturally responsive ?

7 x 3 = 21

Seven	Multiplied by	Two	Equals	fourteen
Seven	Multiplied by	Three	Equals	Twenty-one

Here's another. Seven multiplied by three is twenty-one. Can you repeat that, too?

Seven multiplied by three is twenty-one.

How do we develop CALPS whilst being linguistically and culturally responsive ?

7 x 10 = 70

Seven	Multiplied by	Two	Equals	fourteen
Seven	Multiplied by	Three	Equals	Twenty-one
	Multiplied by		equals	

Can you try this one by yourself?

Seven multiplied by ten equals seventy.

Repeat with scaffolding

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How do we develop CALPS whilst being linguistically and culturally responsive ?

7 x 10 = 70

Seven	Multiplied by	Two	Equals	fourteen
Seven	Multiplied by	Three	Equals	Twenty-one
	Multiplied by		equals	

Can you try this one by yourself?

Seven multiplied by ten equals seventy.

How do we develop CALPS whilst being linguistically and culturally responsive ?

3 x 3 = ____

Ok, what is 3 multiplied by 3?

Three multiplied by three are 9.

How do we develop CALPS whilst being linguistically and culturally responsive ?

Can you ask me a question now?

What is six multiplied by 3?

Six multiplied by three is eighteen. Is that correct?

Yes.

What is	_____	**Multiplied by**	_____ **?**

Where to next?

How do we develop CALPS whilst being linguistically and culturally responsive ?

For problem-based questions, adopt a **Narrow Reading** approach. This ensure that the input you are providing is highly comprehensible, i.e. it barely changes structure. These should also be based on the discourse structures that you have been working with.

-If seven multiplied by two is fourteen, then what is two multiplied by seventeen?

-If two multiplied by three is six, then what is six multiplied by two?

-If two people are multiplied by three oranges, then how

many oranges are there?

-If two people eat three apples, then how many apples

have been eaten?

ChatGPT

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Language proficiency.

Overall gaining language proficiency and mastering the mathematics register is complex and slow

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