MALLI Practices & Mathematical Proficiency Across Languages

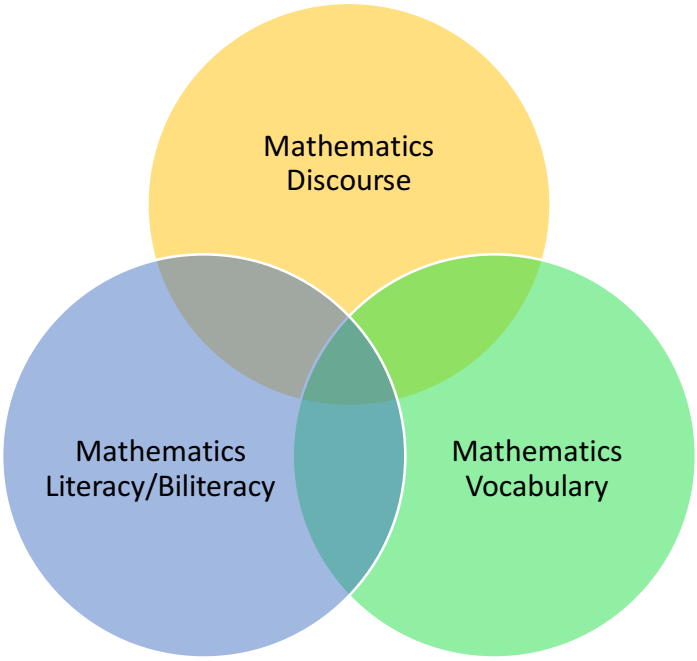

Table 5: Summary of MALLI Teaching Practices

MALLI Practice	Definition	Examples of Strategies & Activities
Mathematics Discourse	Talking and acting to accomplish mathematics practices such as proving or explaining math solutions, problems, or statements	• Connect home and community funds of knowledge to school math. • Increase student interaction. • Cultivate arguments and explanations via math talks. • Promote active listeners. • Promote math discourse.
Mathematics Literacy/Biliteracy	Attention to reading and writing in mathematics including discussions and interpretations of math texts and/or how to produce different types math texts	• math diaries • math learning logs • reflections or observations • share written responses • book of math word problems • Scaffold math textbooks
Mathematics Vocabulary	Attention to special meanings of mathematical words and reinforce specialized and precise meanings through the use of background knowledge, and specific strategies.	• Students analyze keywords in a math text: Tier 1, T 2 & T 3 • Root/suffix/prefix • Cognates • Collocations • Noun phrases/nominalization

Mathematical Proficiency Strands

1. C**onceptual understanding:** comprehension of mathematical ***concepts***, **operations**, and ***relations***;
2. P**rocedural fluency**: skill in **carrying out procedures flexibly**, **accurately**, **efficiently**, and appropriately;
3. S**trategic competence**: ability to formulate, ***represent***, and ***solve*** **mathematical problems**;
4. A**daptive reasoning:** capacity for ***logical thought***, reflection, ***explanation***, and ***justification***; and,
5. P**roductive disposition:** habitual inclination to see mathematics as ***sensible***, ***useful***, and ***worthwhile***, coupled with a belief in diligence and one's ***own efficacy***

Example 1 (K)

The teacher began the math lesson with a story about a woman who owned many cats and lived behind the school.

Ms. Arenas:	Fíjense, mis niños, fíjense que la señora, aquí atrás de la escuela, que vive aquí atrâs. ... *(Listen, my dear children, you know the woman, the woman here behind the school, that lives right here in the back [of the school].)*
Students:	¡Sí! *(nodding heads, indicating that they know the woman to whom she is referring)*
Ms. Arenas:	La señora tenía tres gatos. *(The woman had three cats.)*
Students:	¿¡Tres gatos!? *(Three cats?)*

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Example 2 (1st) Grade

Teacher poses a problem: "Alan has 16 chocolates and Oscar has 6. How many more chocolates does Alan have?"

T: Ella acá tiene 16 chocolates de Adan, a ver agárralos con una manita [She has 16 chocolates here from Adan. Take them in your hand.] (Teacher gives stack of 16 cubes to the girl.)
T: ¿y qué hiciste con los otros? [And then what did you do with the others?] (T is holding a stack of six cubes in her hand.)
S: Los, los, los . . . puse al lado [I placed them side by side.] (T gives stack of six cubes to the girl; she holds both stacks side by side.)
T: Los comparaste . . . [You compared them] (showing with her hands)
T: Ella puso los de Adan y los de Oscar [She put Adan's and Oscar's (cubes) down.] (T indicates S to show the class both stacks side by side.)
T: ¿Cuántos más tenía Adan? [How many more did Adan have?]
S: Diez. [Ten.]
T: ¿Cómo sábes que eran diez más? [How do you know he had 10 more?]
S: Porque los conté como así . . . como de arriba [Because I counted them like this . . . from the top]. (indicates with her hand the direction she counted top to bottom)

Example 3:

Ms. Sandra had six candies. Ms. Mary ate four. How many are left?

Ms. Elba:	Muy bien, ¿y qué pasó? Ms. Mary qué? *(Very good, and what happened? Ms. Mary what?)*
Juan:	Se los comió. *(She ate them.)*
Ms. Elba:	Se comió…¿Cuántos? *(She ate…how many?)*
Juan:	Cuatro. *(Four.)*
Ms. Elba:	O.K., ¿cómo le hizo? *(How did she do it?)* [Juan is staring at his drawing not very sure what to do next] Cómaselos, miam, miam, miam, miam. [imitating the act of eating the candies] *(Eat them…miam, miam, miam, miam.)*

Ms. Elba then posed the following word problem,
"In my fish tank I put five fish and then Ms. Craw gave me three more. How many do I have in the fish tank?

Ms. Elba:	Ay! Now boys and girls Ms. Elba does not know how to read this sentence in English.
Students:	Five plus three [one or two students]
Ms. Elba:	Oh, oh, I didn't know, how are we reading [she is pointing to number 5].
Students:	Five [Ms. Elba says five while pointing to the number.]
Student:	Plus [Ms. Elba is pointing to the plus sign, reads "plus" after the student.]
Student:	Three [Ms. Elba points to the three.]

[Now, Ms. Elba is pointing to the equal sign and one student says: "same".]

Student:	Same as eight.
Ms. Elba:	Five plus three same [pointing to each element in the sentence]
Students:	Same like eight.

Ms. Elba:	O.K. Can we use another word for same? Same is O.K. Same as eight. That's O.K. I like it. But we can say five plus three. How do we say it in Spanish? [pointing to the = sign]
Students:	Igual. *(Equal)*
Ms. Elba:	Igual. *(Equal)* So, it's a very similar word. Five plus three equal…how many?
Students:	Eight.
Ms. Elba:	Eight. Whether you say same it's O.K., but we are gonna try to use the new word. Let's…everybody here…Five plus three equal…
Students:	Eight.

Example 4 (K)

- In this episode, Ms. Arenas used a series of probes (lines 3, 9, and 11) to elicit details of Dalia's strategy and to communicate the discursive norm that one needs to explain one's thinking.
- Additionally, she provided a frame for Dalia's explanation that was based on describing the actions in the story (Y luego me comi' dos, line 7) and explaining how she represented those actions in her drawing (Como sabes cuales son los que comi'?, line 11). We also see how Dalia
- responded in ways that reinforced important discursive norms—by using more mathematical language (i.e., stating that six were left) and referring to visual representations (i.e., indicating that she crossed out circles in her drawing) to communicate her reasoning.

1. Ms. A: *A ver, Dalia, tú no has pasado. Ven a explicar*. ("Let's see, Dalia, you have not come up. Come explain.") [Dalia goes up to the front of the room and takes her whiteboard.]
2. D: *Primero Ms. Arenas se comió . . .* ("First, Ms. Arenas ate . . . ")
3. Ms. A: *¿Cuántos había en cada cajita?* ("How many were there in each box?")
4. D: *Cuatro*. ("Four.")
5. Ms. A: *Okay, muy bien, y pusiste cuatro en cada cajita*. ("Okay, very good, and you put four in each box.") [She has drawn two small squares, with four circles in each square.]
6. D: (nods)
7. Ms. A: *Y luego me comí dos*. ("And then I ate two.")
8. D: *y le quedaron seis*. ("And you were left with six.")
9. Ms. A: *¿Y cómo supiste?* ("And how did you know?")
10. D: *Porque los conté, cuántas bolitas quedaron.* ("Because I counted them, how many little balls were left.")
11. Ms. A: *¿Y las otras? ¿Cómo sabes cuáles son los que comí?* ("And the others? How do you know which ones are the ones I ate?")
12. D: *Estas.* ("These.") [points to two circles that are crossed out]

Dalia solves a multistep problem:

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