

The Universal Language of Mathematics

(Yes, We Do Write in Math Class)

Tina Cardone

What challenges do your students face around language in math class?

Make a list. Compare lists with your neighbor.

Resources: <http://bit.ly/languagemath>

Our Mission

Learn strategies to engage students who do not have access to a curriculum filled with language.

YET

Challenges

What challenges do your students face around language in math class?

Challenges

Who are these students?

- Students learning English
- Students with Language Based Learning Disabilities
- Students reading below grade level

Achievement Gap in Reading

By age 3, less advantaged kids have heard thirty million fewer words than their peers.

As a result the less advantaged children's vocabularies are half the size of other kids.

(Hart and Risley, 1995)

The Plan

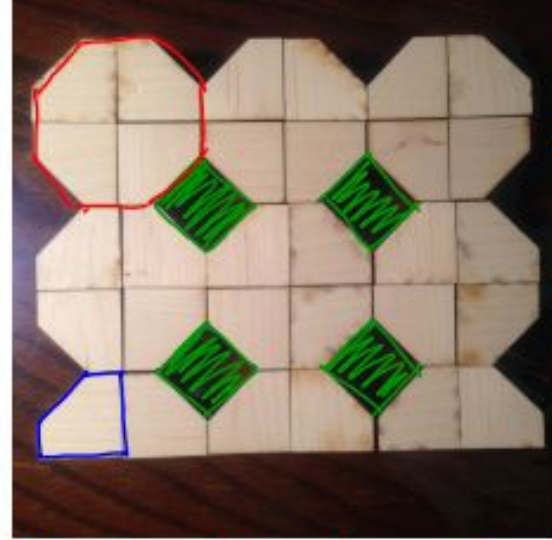
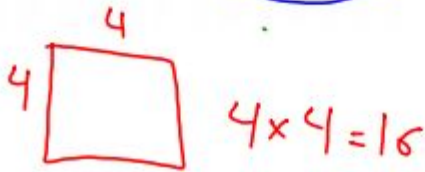
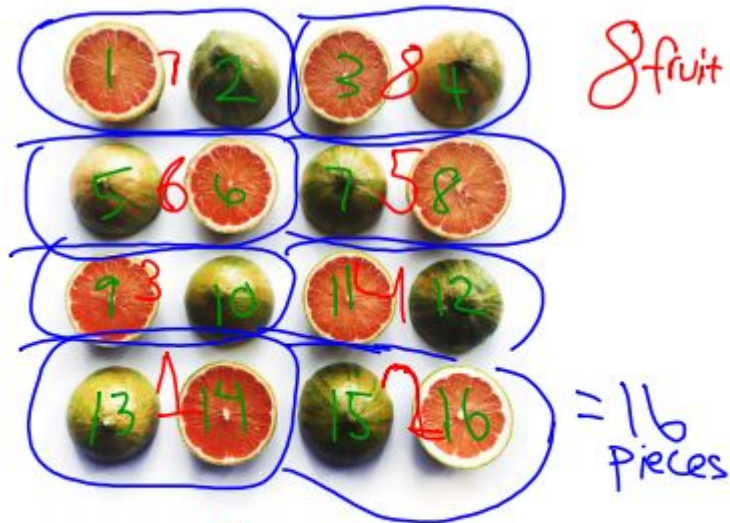
1. Use the language students have
2. Teach them new language
3. Support them in practicing and applying that language

How Many?

ntimages.weebly.com



How Many?



4 rhombuses
30 diamonds
9 octagons
36 rhombuses
1 background

Rhombus: 4 sides
all equal  = square and rhombus

Pentagon: 5 sides 30 pentagons

Octagon: 8 sides

$$6 \text{ octagons} + 3 \text{ semi-octagons} \\ 4 \cdot 6 + 2 \cdot 3 = 30$$

How Many?

Students Learning English: encourage translation, write in native language.

Students with Disabilities: single words or short phrases are all we expect

They Have Language

Let them (make them) use it.

Start units with a card sort, polygraph or notice and wonder.

- 1) What relevant background information can they connect?
- 2) What do they remember from previous courses?
- 3) What are they noticing but lack a precise word for?

Native Language

“The findings of more than three decades of research confirm that bilinguals who learned a second language in late childhood or adulthood favor their first language for mental computations. They are also **faster at remembering** numbers and solving mathematical problems in that language.”

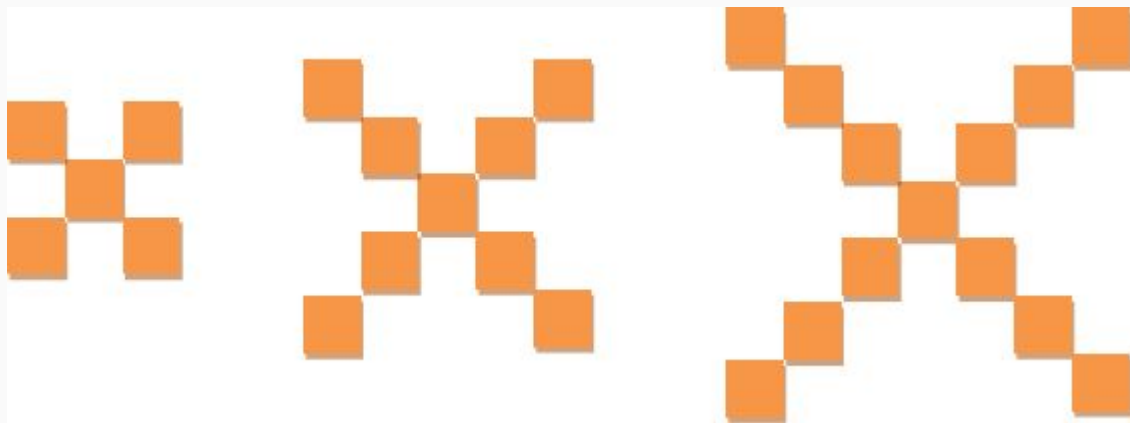
(Grosjean, 2015)

Visual Patterns

Draw the next figure.

Describe the pattern.

Compare with your neighbor.

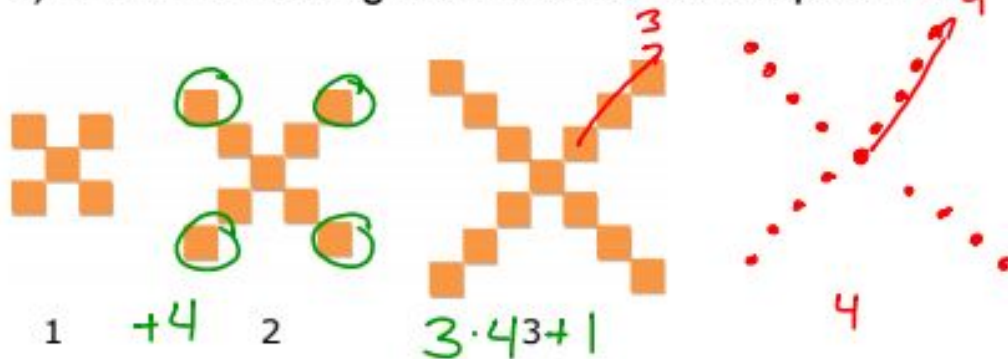


Visual Patterns

1) Take out your homework

2) Set up your journal: (date, do now)

3) Draw the next figure and describe the pattern.



Add one to each branch
Add 4 squares

10th Figure: $10 \cdot 4 + 1$

n^{th} figure: $n \cdot 4 + 1$

Visual Patterns

Students Learning English: provide vocab
(shape names)

Students with Disabilities: model annotating

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Teach Vocabulary

“Traditional methods of teaching words are ineffective... we can best support students’ language acquisition with rich, frequent vocabulary instruction that introduces new terms as part of an interconnected web of meaning”

(Hoffer, 2016, p. 65)

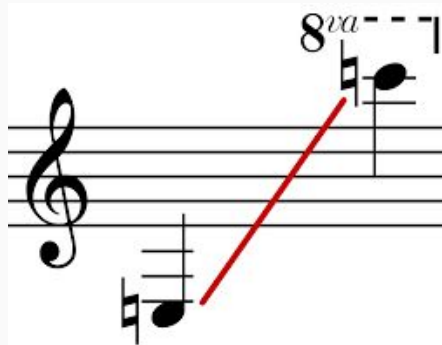
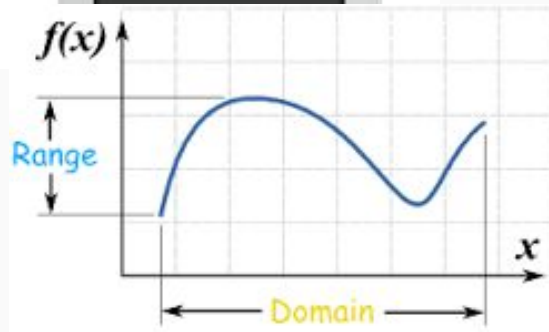
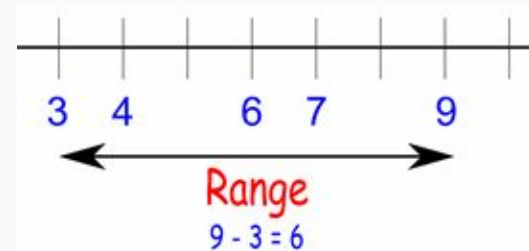
Math Supports Language

Teach prefixes, suffixes and root words.

Recognize when students' background knowledge helps.

Recognize when words are easily confused with others.

Range



Network

- Make friends with the English teachers, ELL teachers, special ed teachers, and specialists (reading and speech).
- Find out students' levels, what they're learning and consider how you can reinforce those skills.
- Use #SwDMathChat and #MathandELL

Teach Vocabulary

Six-step vocabulary instruction was found to increase student achievement by 24 percentage points.

(Marzano, 2004)

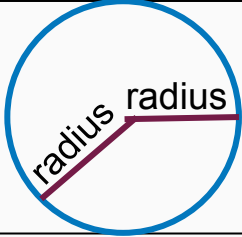
1. Provide a definition, explanation, and example.
2. Ask students to restate definitions in their own words.
3. Ask students to construct a picture or symbolic representation of the term.

Teach Vocabulary

Six-step vocabulary instruction was found to increase student achievement by 24 percentage points (Marzano, 2004)

4. Engage students in activities that help them add to their knowledge.
5. Ask students to discuss the terms with one another.
6. Involve students in games that enable them to play with terms.

TIP Chart

Term	Information	Picture
Radius	Segment connecting the center to the edge of a circle.	

Steps 1-3: TIP chart

Steps 4-6: activities - remind kids to refer to their charts!

Word Wall

Out of context words aren't helpful.
Words with pictures and definitions are.

Create structure!
Put related terms together.

Use it - refer to it often.
Make it big and clear enough to see.

Translate for your ELLs when possible.



The Plan

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Repetitions

4 exposures for students who have broad vocabulary
14 exposures for typical students
40 exposures may be needed for English language learners or students with disabilities.

(Marzano, 2004)

Journaling

At the end of each class students reflect.

One content question. One general question.

Metacognition promotes student engagement, deepens understanding, and leverages achievement.

(Hattie, 2009)

Journaling

Students Learning English: provide sentence frames, don't judge spelling

Students with Disabilities: accept simple sentences but challenge them at their level

Make an Argument

Is 5.2 an even number?

What is your first impression?

Do some calculations to help you decide:

Is 8 even? Is 9 even? Is 0 even? Is 0.2 even?

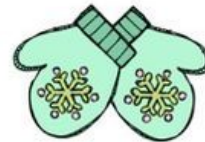
In a paragraph explain which you would choose.

Provide three reasons. At least one reason should include the math you did.

odd



even



Make an Argument

I believe that 5.2 is an even number because .2 is even, and it doesn't really matter what the first number is. To figure out if a number is even or odd you have to divide by 2, which I did. $5.2 \div 2$ is 2.6. 2 and 6 are both even numbers so 5.2 must be considered even. 9 is not an even number because $9 \div 2$ is 4.5 and .5 is odd, but I did have a question about this. If 4.5 is considered "odd" because of the last digit, would 4.50 be considered even since 0 is an even number? I mean both are the same thing but one is just simplified. I am really confused...

Make an Argument

Students Learning English: provide sentence frames and/or allow bulleted lists

Students with Disabilities: Some students may just fill out a graphic organizer, that's fine!

Discussion Follows the Math

Do not ask students to grapple with math and language simultaneously.

Students who complete fewer problems with explanations will learn and understand more than students who complete pages of calculations without any discussion.

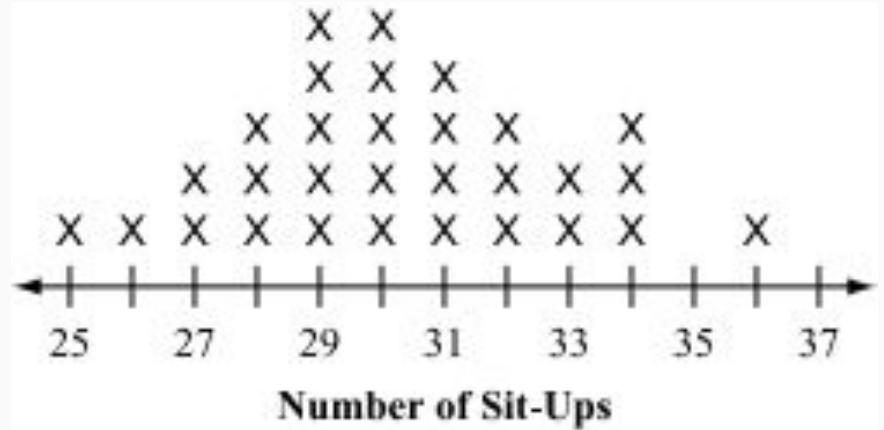
(Senk and Thompson, 2003)

Reading Math

1. Notice and wonder without the question
2. Annotate
3. Discuss the vocabulary
4. Organize the information

Reading Math

- Diagrams
- Equations
- Graphs
- Tables
- Formulas



Reading Math

Students Learning English: make sure they understand all the vocabulary, not just content.

Students with Disabilities: read the problem multiple times and make sure they are seeing everything.

The Plan

1. Use the language students have
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Remember,
these strategies
are good teaching
for all students.

INSPIRED BY A PUBLIC SCHOOL STUDENT WITH DISABILITIES



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CLEARING A PATH
FOR PEOPLE WITH SPECIAL NEEDS
CLEARS THE PATH FOR EVERYONE!

Resources

Google doc: <http://bit.ly/languagemath>

- All quoted sources
- Blog posts about activities and strategies
- Templates and reference materials

Twitter: @crstn85

Email: tina.cardone1@gmail.com