Making Math Meaningful:

Strategies for Developing Academic Vocabulary

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National Board Certified Teacher
Why I Love Kids...
New ways of learning... new ways of thinking
New ways of learning... new ways of thinking
Kids are Awesome!
Session Agenda

• Research and rationale for developing math vocabulary
• Strategies & activities for developing math vocabulary
What does “2” mean in each example?

- 2
- To
- Too
- Two
- 24
- 1/2
- 10^2
- ft^2
Common Core Connections

Content Standards
• Counting & Cardinality
• Operations & Algebraic Thinking
• Number and Operations in Base Ten
• Number and Operations – Fractions
• Measurement & Data
• Geometry

Mathematical Practices
• MP2 – Reasoning
• MP3 – Argumentation
• MP4 – Mathematical Models
• **MP6 - Precision**
Speaking of Precision...
3. Find x.

Here it is.
PETER

1.21

4c) Expand

\[(a+b)^n\]

\[= (a + b)^n\]

\[= (a + b)^n\]

\[\times \text{etc.} \]

\[\text{Red pen:} \text{Very funny, Peter.}\]
Relevant Literature

Classroom Instruction That Works by Robert Marzano:

- “...systematic vocabulary instruction is **one of the most important instructional interventions** that teachers can use, particularly with low-achieving students.”

- “...systematic vocabulary instruction is **rare** in U.S. schools.”

- “...student achievement will increase by 33 percentile points when vocabulary instruction focuses on **specific words that are important** to what students are learning.”
Relevant Literature

Building Background Knowledge for Student Achievement by Robert Marzano

• “...direct vocabulary instruction has an impressive track record of improving students’ background knowledge and the comprehension of academic content.”

• “...when people first learn words, they understand [word definitions] more as descriptions of words as opposed to definitions.”

• “...Stahl and Fairbanks demonstrated the effectiveness of both language-based strategies...and nonlinguistically based strategies.”
Relevant Literature

Bringing Words to Life: Robust Vocabulary Instruction by Isabel Beck, Margaret G. McKeown, Linda Kucan

• “...it is precarious to believe that naturally occurring contexts are sufficient, or even generally helpful, in providing clues to promote initial acquisition of a word’s meaning.”

• “...students become interested and enthusiastic about words when instruction is rich and lively...”
Developing Math Vocabulary

• Read, write, speak, listen
• Language vs. math vocabulary development
• First lesson - 4-6 different uses
• Within a few days - 30 uses
• Pictorial examples!!! - 80% of people are visual learners
• Graphic Organizers
Using Graphic Organizers

WATCHA KIDS UP TO?

MAKIN' SNOW ANGLES.
What should students know & be able to do?

- Define
- Pronounce
- Draw
- Give examples
- Use in writing
- Use verbally

- Recognize as sight words
- Identify in real-life
- Compare/contrast
- Visualize
- Integrate
Frayer Model

<table>
<thead>
<tr>
<th>What it is</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>Non-Examples</td>
</tr>
</tbody>
</table>
Relevant Literature

- Strong relationship between vocabulary...
  - and intelligence
  - and one’s ability to comprehend new information
  - and one’s level of income

- Systematic vocabulary instruction -
  - One of most important interventions
  - Especially with low-achieving students
  - Rare in U.S. schools

*Robert Marzano - Classroom Instruction That Works*
Relevant Literature

Generalizations

1. Students must encounter words in context more than once to learn them.

2. Instruction of new words enhances learning those words in context.

3. One of the best ways to learn a new word is to associate an image with it.

4. Direct vocabulary instruction works.

5. Direct instruction on words that are critical to new content produces the most powerful learning.

*Robert Marzano - Classroom Instruction That Works
Suggestions from Marzano

Limit vocabulary lists (e.g., only focus on 5-7 key words for a 3-week unit)

Process for Teaching New Terms and Phrases:

1. Present explanation or description
2. Present nonlinguistic representation
3. Students generate explanations or descriptions
4. Students create nonlinguistic representations
5. Periodically ask students to review accuracy of their own explanations, definitions, and/or representations

*Robert Marzano - Classroom Instruction That Works
Techniques from SEI Classrooms

• Sing or chant words
• Use physical gesture and/or act out
  – Kids make up gestures
  – You act it out & they verbalize
  – You verbalize & they act it out
• Illustrate words
• Create posters using student representations
• Systematic review – “Snap!”
Using Games

Snap!

Granola Mom 4 God
Using Games

WORDO (Math BINGO)
Using Games
WORDO (Math BINGO)

Write each of these words in a different space:

mile  foot  yard  inch  cup  quart  gallon  ounce  pound
Using Games
Card Games – Christopher
Using Games

Board Games – Language Expectations

ONE-TWO SWITCHEROO: Multiplying to 81
Game Board

DRAW PILE

1st card: Multiplication Statement
$a \times b = c$

2nd card: Commutative Statement
$a \times b = b \times a$

30

63

45

40

42

27

24

20

36

28

72

48

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New ways of learning... new ways of thinking
<p>| | | | | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>8 x 9</td>
<td>9 x 8</td>
<td>7 x 4</td>
<td>4 x 7</td>
<td>9 x 6</td>
<td>6 x 9</td>
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<td>4 x 6</td>
<td>5 x 6</td>
<td>6 x 5</td>
<td>7 x 8</td>
<td>8 x 7</td>
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<td>4 x 9</td>
<td>9 x 4</td>
<td>9 x 3</td>
<td>3 x 9</td>
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<td>6 x 8</td>
<td>8 x 6</td>
<td>5 x 8</td>
<td>8 x 5</td>
</tr>
</tbody>
</table>

**ONE-TWO SWITCHEROO: Multiplying to 81**

**Cards**

- **Chance**: Discard and pick
- **Chance**: Discard and pick
- **Chance**: Take a card
- **Chance**: Take a card
- **Chance**: Take a card

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New ways of learning... new ways of thinking
Using Math Word Banks

• **Student achievement** in mathematics will improve since they have a better grasp of the vocabulary, both written and oral.

• **Teachers** will use math vocabulary more consciously

• **Consistency** from room to room, grade to grade, and school to school
Using Math Word Banks
If you wish to color code...

- Number Sense - pink
- Data Analysis, Probability, & Discrete Math - yellow
- Patterns, Algebra, & Functions - white
- Geometry - green
- Measurement - blue
- Logic - goldenrod
Using Math Word Banks

Types of Math Word Banks

- Bulletin boards
- Magnetic boards
- Charts
- Portable word banks
Using Math Word Banks
Portable Word Banks

- Portable Word Banks
  - Individualize the word banks for a closer view
  - Use a format that kid can take with them when they go to special classes
Using Vocabulary Riddles
# Using Vocabulary Riddles

## Word Bank – Measurement Example

<table>
<thead>
<tr>
<th>Attribute</th>
<th>U.S. Customary</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>inches, feet, yards, miles</td>
<td>millimeters, centimeters, meters, kilometers</td>
</tr>
<tr>
<td>Weight</td>
<td>ounces, pounds</td>
<td>grams, kilograms</td>
</tr>
<tr>
<td>Capacity</td>
<td>cups, pints, quarts, gallons</td>
<td>milliliters, liters</td>
</tr>
</tbody>
</table>
Using Word Sorts

• Word Sorts
  – Word type
  – Vowels
  – Initial Consonants
  – Concepts
  – Categories
Using Vocabulary “Tests”

• Vocabulary “Tests”
  – Leave word bank visible
  – Give definitions, illustrations, or clues
  – Have kids list the words
Using Vocabulary “Tests”
Measurement Word Bank

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>inches</td>
<td>millimeters</td>
</tr>
<tr>
<td></td>
<td>feet</td>
<td>centimeters</td>
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<td>yards</td>
<td>meters</td>
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<td></td>
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<td>kilometers</td>
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<tr>
<td>Weight</td>
<td>ounces</td>
<td>grams</td>
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<tr>
<td></td>
<td>pounds</td>
<td>kilograms</td>
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<td>Capacity</td>
<td>cups</td>
<td>milliliters</td>
</tr>
<tr>
<td></td>
<td>pints</td>
<td>liters</td>
</tr>
<tr>
<td></td>
<td>quarts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gallons</td>
<td></td>
</tr>
</tbody>
</table>
Using Vocabulary Journals

• Spiral notebooks/steno pads
• 3-ring binders
  – Allows for organization
  – Personal favorite - organize by strand
• Simple - 4 boxes
• Graphic organizer - Frayer model
• Commercial - grid paper & lines
# Using Vocabulary Journals

## Simple Journal Page

<table>
<thead>
<tr>
<th>digit</th>
<th>place</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>value</th>
<th>hundred’s place</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Strand: Geometry**

**Rectangle:** A four-sided shape with 4 right angles.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Rectangle Example" /></td>
<td><img src="image2" alt="Non-Rectangle Example" /></td>
</tr>
</tbody>
</table>

**Square:**

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Square Example" /></td>
<td></td>
</tr>
</tbody>
</table>

**Rhombus:**

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4" alt="Rhombus Example" /></td>
<td></td>
</tr>
</tbody>
</table>

**Quadrilateral:**

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Quadrilateral Example" /></td>
<td></td>
</tr>
</tbody>
</table>

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A Note on Teacher Talk
Ones...Tens...Hundreds
If you can’t explain it simply, you don’t understand it well enough.

– Albert Einstein
“Hey mom, look at the kitties!”
In closing...

- **Direct instruction** of vocabulary is highly supported by research as one of the most effective interventions.
- For more information, see books by **Robert Marzano**
  - *Classroom Instruction That Works*
  - *Building Background Knowledge for Student Achievement*
- **Borrow** ideas from Language Arts & SEI programs.
Remember... “talk the talk as you walk the walk”
Committed Action Step

Select one activity you learned during this presentation to use with students in the first week of school...
You don't have to see the whole staircase, just take the first step.
Contact Info

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Group Solutions

- **Group Solutions** from GEMS
  - Cooperative activities
  - Heavy on vocabulary development

- Also see **United We Solve** for older students