Supporting English Learners in Elementary Mathematics

OELAS
December 6, 2018

Time: 1:15 – 2:30pm (Session 2)
Room: Tucson C – D

Annette Gregg
What is WestEd?

WestEd is a nonprofit research, development, and service agency that works with education and other communities to promote excellence, achieve equity, and improve learning for children, youth, and adults.

EL Services is a part of WestEd’s Comprehensive School Assistance Program (CSAP) that supports schools and districts to bridge the gap between research and practice specifically to enhance outcomes for English learners.
"You can’t learn math without language. There is an old idea that you can work around the language, and just get to the content. This isn’t true."

- Phil Daro

*Unlocking Learning II Math as a Lever for English Learner Equity, March 2018*
“Recognizing how language and math learning actually enhance and amplify one another is key to understanding how math instruction should be approached with students’ language needs at the center of every lesson.”

*Unlocking Learning II Math as a Lever for English Learner Equity, March 2018*
Quick Write

Take two minutes to jot down responses to the following questions:

*What are the language demands of mathematics?*

*How can language and mathematics enhance and amplify each other?*
One of the sides of the horse pen blew over and needs to be replaced. Farmer Sara needs to buy new fence material for the missing side. The perimeter of the whole horse pen is 76 feet. What is the measurement of the missing side? Explain two ways you could find this out.

What are some of the language demands of this problem that teachers need to be aware of in order for EL students to be successful?
Math and English Learners

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- 3rd Grade Performance Task

- Multiple meaning words
- Change in verb tense (past to present)
- Causal conjunctions
- Math vocabulary
- Genre: Explanation
- Referents
Standards for Mathematical Practices

MP.1 Make sense of problems and persevere in solving them.
MP.2 Reason abstractly and quantitatively.
MP.3 Construct viable arguments and critique the reasoning of others.
MP.4 Model with mathematics.
MP.5 Use appropriate tools strategically.
MP.6 Attend to precision.
MP.7 Look for and make use of structure.
MP.8 Look for and express regularity in repeated reasoning.
Mathematics Content and Language Working in Tandem: High-yield Pedagogical Practices

• **High-yield**: something that produces maximized results

• **Pedagogy**: the art, science, or profession of teaching
High-yield Pedagogical Practice: Model Lesson

Unpacking Word Problems
## Key Linguistic Features in Word Problems

<table>
<thead>
<tr>
<th>Question</th>
<th>Language Features</th>
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</thead>
<tbody>
<tr>
<td>What is the problem to be solved?</td>
<td>• Questions</td>
</tr>
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<td></td>
<td>• Commands</td>
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<td>• Conjunctions</td>
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<td>What relevant information is provided in the text?</td>
<td>• Technical vocabulary</td>
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<td>• Complex noun groups</td>
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<td></td>
<td>• Nominalizations</td>
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<td>• Ellipsis (...)</td>
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<td></td>
<td>• References (pronouns, demonstratives)</td>
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<td>• Being processes (is/are/has/have)</td>
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<td>• Conjunctions</td>
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# Features of Word Problems

| Purpose | To put math in context  
To allow opportunities to demonstrate reasoning and conceptual understanding  
To show students that math is everywhere |
|---|---|
| Structure | Introduction with background information  
Descriptive facts & details about the problem  
Ends with an “ask” of the reader to do or solve something. This can be a question or with a command such as “explain” or “describe”. |
| Cecilia and Larry are going to a pet shop. Cecilia has three times more money than Larry does. Cecilia has $24. How much money would they have to spend if they combine their money together? |
| Language Features | Past, present, or future tense verbs (She bought three bags of flour; Louis has $8; How much would they have to spend?)  
Long noun phrases (The kids must combine their money so that they can purchase all of the things they will need for their trip.)  
Comparative connectives: greater than, less than, more, etc. (Sheila has 16 fewer marbles than Dominic.)  
Sequential connectives: first, next, finally, before, etc. (First, Sara ran 3 miles. Then she ran another 4 miles. Ticket prices increase by $2 after 6pm.)  
Causal connectives: when, because, so that, due to, etc. (When winter comes, the average temperature drops by 14°.)  
Question words and phrases that request information (How many…? Indicating quantity; What…? or Which…? Indicating a choice will be made between two or more possible answers; Why…? Indicating an explanation)  
Simple, compound and complex sentences (Bob had three kittens; José had six dogs and three cats; Jane has to buy breakfast, lunch and dinner for seven people for the week, but cannot exceed a $500 budget.)  
Noun groups that include quantifiers (She then added ½ cup of sugar and boiled it for 20 minutes.)  
Domain specific and general academic vocabulary (She will add 50 ml of de-chlorinated water to the sample jar; The price of the grain increased by 6% over two years; Determining how much each toy cost; Explain how many laps each car completed in the time allowed.) |
High-yield Pedagogical Practice: Model Lesson

Your Role:
- Be a learner. (So you can experience what it’s like for your students to do this.)
- Fully participate in the learning. (We’ll debrief afterward to discuss how to apply this to your classroom.)
Learning Target

We will unpack and discuss the meanings of sentences in a word problem to understand the language structures, vocabulary, and math concepts needed to solve the problem.
Ms. McCrary wants to make a rabbit pen in a section of her lawn. Her plan for the rabbit pen includes the following:

- It will be the shape of a rectangle.
- It will take 24 feet of fence material to make.
- Each side will be longer than 1 foot.
- The length and width will measure whole feet.

What makes this prompt challenging? What do you think it’s asking you to produce?
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**PART A:**

Draw 3 different rectangles that can represent Ms. McCrary’s rabbit pen. Be sure to use all 24 feet of fence material for each pen. Use the grid.
Ms. McCrary wants to make a rabbit pen in a section of her lawn.

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As you unpack the sentences in the word problem, discuss with your partner:

- Who or what is this chunk about?
- What is the ‘who’ or ‘what’ doing?
- What new information does this chunk add?
- What does the phrase _____ mean or do?
- Is this a context sentence or an ask or task sentence?
Let’s Take a Look at the Lesson Plan...

**Talk with your table:**

- How does the lesson support students’ development of content knowledge and language?

- How were mathematical language routines used as scaffolds in the lesson, or how could they be?
Preparing for a Word Problem Unpacking Lesson

- Write the sentences on register tape.
- Tear the dense, packed sentence into “chunks”.
- Create questions or prompts to highlight the meaning of each chunk (to unpack it).
1st Grade Example:
Maria is having a party for 17 of her friends. She already invited some friends. She has 12 more invitations to send. How many friends has she already invited?

4th Grade Example:
Justin is packing a container with books.
- The dimensions of each book are 8 inches by 6 inches by 2 inches.
- The dimensions of the container are 16 inches by 12 inches by 12 inches.
- All of the books and the container are rectangular prisms.
- How many books can fit into the container if the books are packed so that there is no unused space in the container?
Let’s Debrief the Day…

I used to think...
Now I think...
As a result, I will...

Share with a partner.
“Treating ELs as the people they can become means that we see students not in terms of what they lack—in their case, full control of academic English—but as capable and intelligent learners who, with the right kind of support, are as able to participate in learning and achieve academically as their English-(proficient) peers.”

- Pauline Gibbons

Scaffolding Language/Scaffolding Learning (2015)