Supporting English Learners in Secondary Mathematics

CABE – March 21, 2019
Time: 3:15pm – 4:30pm
Room: Hyatt Regency, Shoreline A

Presenter: Mark Jutabha, Ed.D.
mjutabha@wested.org

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?

Math and English Learners

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?
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.

3rd Grade Performance Task

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

Standards for Mathematical Practice

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.
Guiding Questions to Develop Mathematical Practices

<table>
<thead>
<tr>
<th>Questions to Develop MP 1</th>
<th>Questions to Develop MP 2</th>
<th>Questions to Develop MP 3</th>
<th>Questions to Develop MP 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make Sense of Problems and Perservere in Solving Them</td>
<td>Reason Abstractly and Quantitatively</td>
<td>Construct Viable Arguments and Critique the Reasoning of Others</td>
<td>Model with Mathematics</td>
</tr>
<tr>
<td>• What is the problem asking?</td>
<td>• What does the number _______ represent in the problem?</td>
<td>• How is your answer different than ______-s?</td>
<td>• Write a number sentence to describe this situation.</td>
</tr>
<tr>
<td>• How can you start this problem?</td>
<td>• How can you represent the problem with symbols and numbers?</td>
<td>• How can you prove that your answer is correct?</td>
<td>• What do you already know about solving this problem?</td>
</tr>
<tr>
<td>• How could you make this problem easier to solve?</td>
<td>• What is a representation of the problem?</td>
<td>• What math language will help you prove your answer?</td>
<td>• What connections do you see?</td>
</tr>
<tr>
<td>• How is ______ related to?</td>
<td>• What is the relationship of the quantities?</td>
<td>• What examples could prove or disprove your argument?</td>
<td>• Is the working or do you need to change your model?</td>
</tr>
<tr>
<td>• What information is given in the problem?</td>
<td>• ______ is related to?</td>
<td>• What do you think about ______-'s argument?</td>
<td>• What is the equation or expression that matches the diagram, number line, chart, table?</td>
</tr>
<tr>
<td>• What are you having trouble with?</td>
<td>• What does ______ mean to you? (symbol, quantity, diagram, etc.)</td>
<td>• What questions do you have for ______?</td>
<td>• Where did you see one of the quantities in the task in your equation or expression?</td>
</tr>
<tr>
<td>• Describe what you have already tried. What might you change?</td>
<td>• What properties might we use to find a solution?</td>
<td>• What mathematical evidence would support your solution?</td>
<td>• How would it help to create a diagram, graph, table?</td>
</tr>
<tr>
<td>• Talk me through the steps you’ve used to this point?</td>
<td>• How did you decide in this task that you needed to use?</td>
<td>• Will it still work if ______?</td>
<td>• What are some ways to visually represent?</td>
</tr>
<tr>
<td>• What steps in the process are you most confident about?</td>
<td>• What are some other problems that</td>
<td>• How did you decide to try that strategy?</td>
<td>• What formula might apply to this situation?</td>
</tr>
<tr>
<td>• What are some other strategies you might try?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mathematics Content and Language Working in Tandem: Keystone Pedagogical Practices

Keystone: something on which other things depend for support

Pedagogy: the art, science, or profession of teaching
## Keystone Pedagogy: Model Lesson

### Unpacking Word Problems

#### Key Linguistic Features in Word Problems

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

Keystone 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.

Consider the following prompt:

An artist used silver wire to make a square that has a perimeter of 40 inches. She then used copper wire to make the largest circle that could fit in the square, as shown below.

What makes this prompt challenging? What do you think it’s asking you to produce?
An artist used silver wire to make a square that has a perimeter of 40 inches. She then used copper wire to make the largest circle that could fit in the square, as shown below.

PART A:
How many more inches of silver wire did the artist use compared to copper wire? (Use $\pi = 3.14$.) Justify your response.

<table>
<thead>
<tr>
<th>Text Chunk</th>
<th>What Does It Mean?</th>
<th>Mathematical Wonderings</th>
</tr>
</thead>
<tbody>
<tr>
<td>An artist used silver wire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to make a square</td>
<td></td>
<td></td>
</tr>
<tr>
<td>that has a perimeter of 40 inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>She then used copper wire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to make the largest circle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>that could fit in the square, as shown below</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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).

How many more inches of silver wire did the artist use compared to copper wire? (Use $\pi = 3.14$) Justify your response.
How many more inches of silver wire did the artist use compared to copper wire? (Use $\pi = 3.14$) Justify your response.

<table>
<thead>
<tr>
<th>Text Chunk</th>
<th>What Does It Mean?</th>
<th>Mathematical Wonderings</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many more inches of silver wire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>did the artist use compared to copper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wire?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Use $\pi = 3.14$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Justify your response.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Let’s Debrief the Day...

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

Share with a partner.
Want More?

https://leadingwithlearning.wested.org/

Parting Thoughts...

“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)
Thank you!

Mark Jutabha, Ed.D.
mjutabha@wested.org