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Strategies for Supporting English Learners in the Standards for Mathematical Practice

An Inspiration

“For English Learners to succeed in learning mathematics, they need to be more *productive* in mathematics classrooms—reasoning more, speaking more, writing more, drawing more.”

Maria Santos

Former Director, NYC OELL

The Verbs of Mathematical Practice

1. **Make sense** of problems and **persevere** in solving them.
2. **Reason** abstractly and quantitatively.
3. **Construct** viable arguments and **critique** the reasoning of others.
4. **Model** with mathematics.
5. **Use** appropriate tools strategically.
6. **Attend to** precision.
7. **Look for** and **make use** of structure.
8. **Look for** and **express** regularity in repeated reasoning.

Mathematics Coaching Supporting English Learners (MCSEL)

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Mathematics Coaching Supporting English Learners (MCSEL)

- Develop and study materials to support learning of grades 6-8 mathematics teachers of students who are English learners (ELs)
 - Materials to guide seminar series for teachers
 - Materials to guide Classroom Inquiry Cycles after each seminar

Key Conjectures about Providing Access for EL Students

- Visual representations will support ELs' mathematical thinking
- Language strategies, integrated into instruction, will support ELs' mathematical productivity

Mathematical Visual Representations

Includes:

- *Drawing* (e.g., enhancing figures in geometry tasks)
- *Diagramming* (e.g., when thinking about word problems and other quantitative tasks)

Across the materials

- 1. Make sense of problems and persevere in solving them.**
2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.**
4. Model with mathematics.
5. Use appropriate tools strategically.
- 6. Attend to precision.**
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

When number and algebra word problems are the content

1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.**
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

When the focus is geometric reasoning and measurement

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
- 7. Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Instructional Routines

- Visual representations as thinking and problem solving tools
- Instructional routines to support:
 - Creating diagrams or geometric drawings
 - Analyzing diagrams or geometric drawings
- Integrated language strategies
- Analyzing Visuals: ELs engaged in more mathematical communication, using more academic language

Estella's Thinking

-My Tunes-



GOALS

- ✓ Get better at making sense of someone else's math thinking.
- ✓ Learn how diagrams can show information and relationships to help you solve a problem.

3-Reads

Dario, Aziza, and Cassie bought songs online from My Tunes. Dario bought 45 more songs than Aziza.

Aziza bought 15 more songs than Cassie.

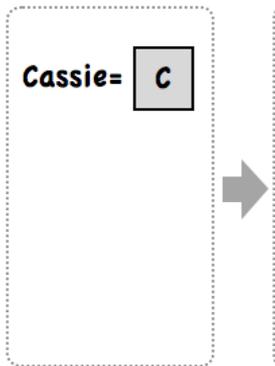
Together they bought 300 songs. How many songs did Dario buy?

1. What is the Problem about?
2. What do you need to find out?
3. What important information is given?

Estella



Step 1



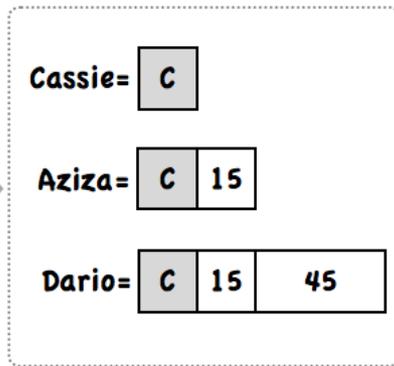
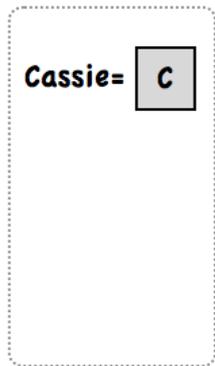
What do you notice?

Estella



Step 1

Step 2



What changed from Step 1 to Step 2?

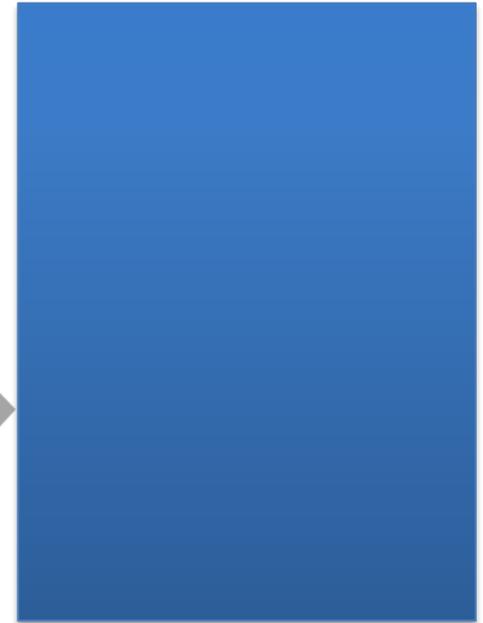
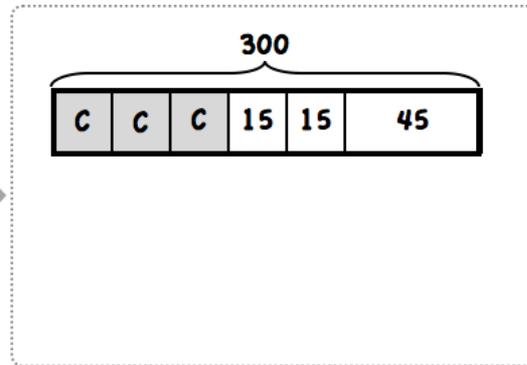
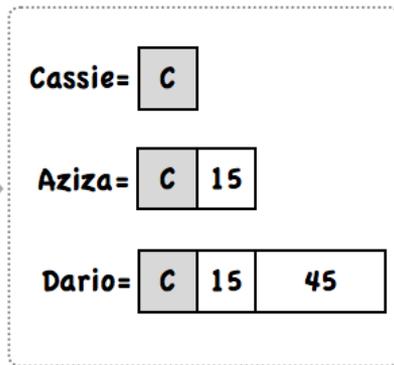
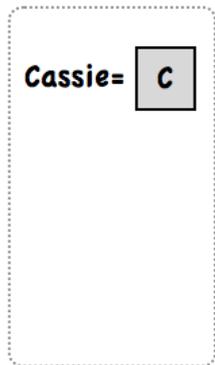
Estella



Step 1

Step 2

Step 3

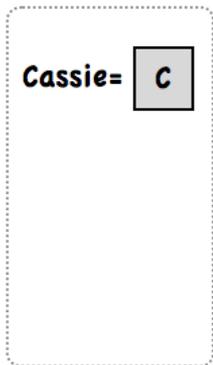


What changed from Step 2 to Step 3?

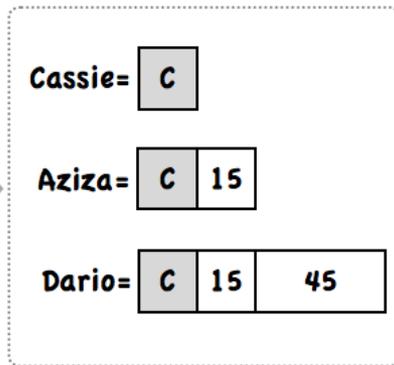
Estella



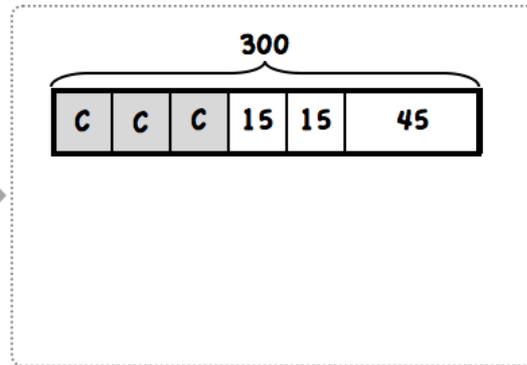
Step 1



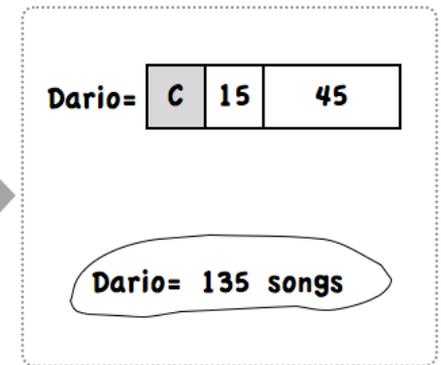
Step 2



Step 3



Step 4

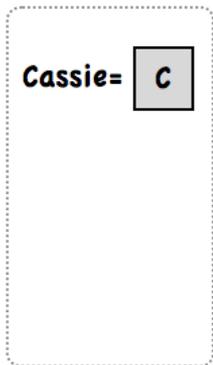


What changed from Step 3 to Step 4?

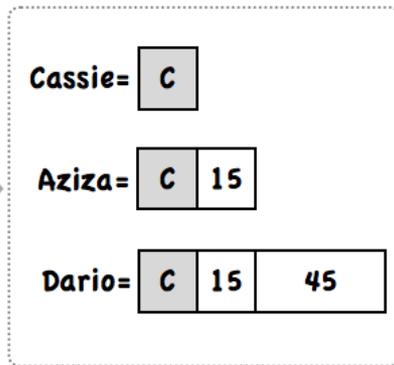
Estella



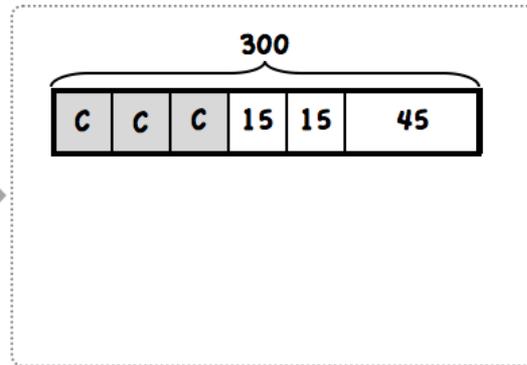
Step 1



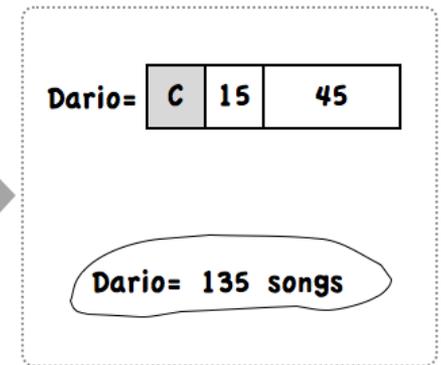
Step 2



Step 3



Step 4

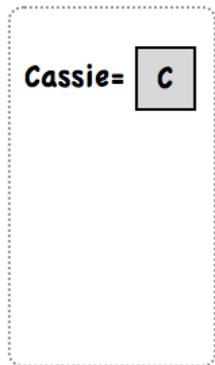


I wonder...

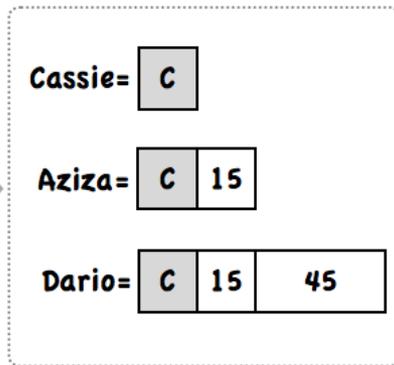
Estella



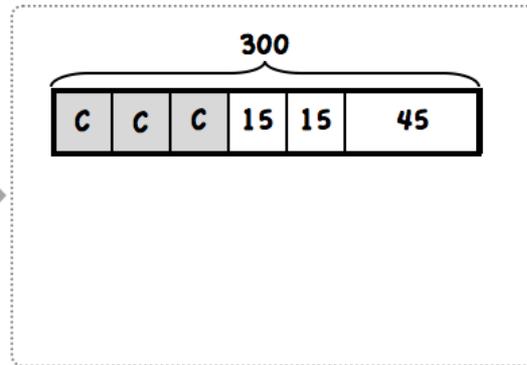
Step 1



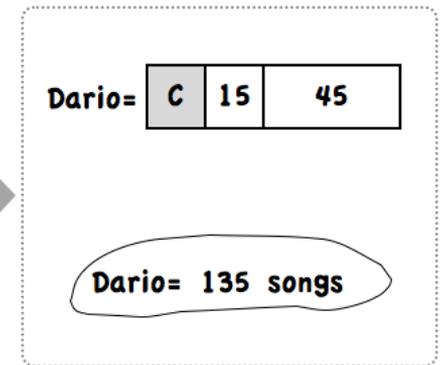
Step 2



Step 3



Step 4



What words will be helpful to describe Estella's strategy?

Estella



What words will be helpful to describe Estella's strategy?

- **Number of**
- **More than**
- **Quantity/quantities**
- Total
- Represents/represented
- Shows/showed
- Combine/combined

What was Estella thinking?

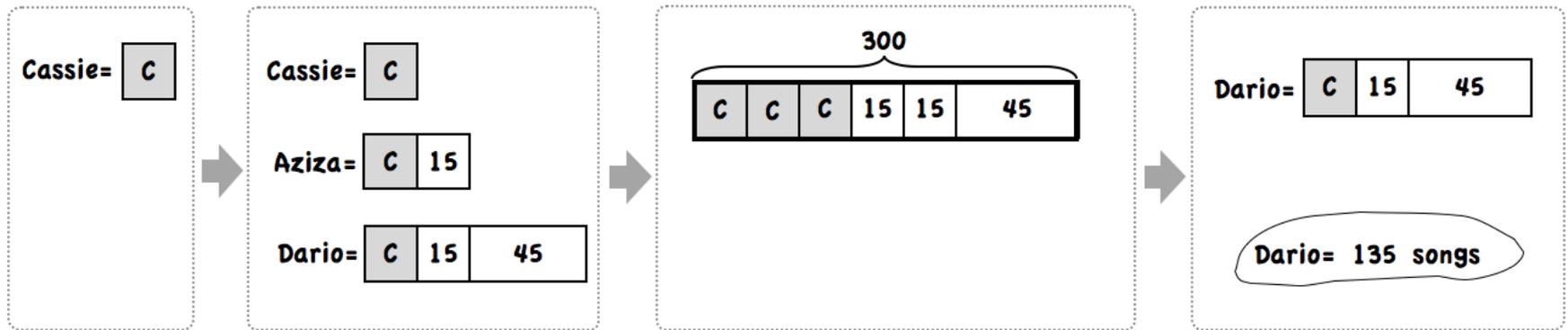


Step 1

Step 2

Step 3

Step 4



First Estella...

Next she...

Then she...

Finally she...

Estella discovered...

What was Estella Thinking?

First Estella...

Next she...

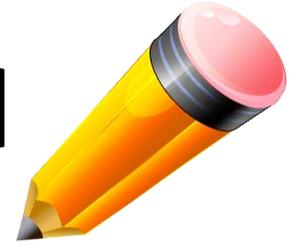
Then she...

Finally she...

Estella discovered...

I agree / disagree
with...
because...

Write about what you learned



- When representing quantities in a diagram I will...because ...
- The next time I create a diagram, I will because...
- An important characteristic of a useful diagram is... because...

Analyzing Diagrams Routine

Brief Reflection on Supporting EL Students

- **Diagramming:** How does it support students' diagramming and mathematical reasoning?
 - In what ways does it support the Standards for Mathematical Practice?
- **Language Supports:** How does it support their language access and their language production?
 - How could these supports be used differently depending on the *English proficiency levels* of students?

Your Turn

Individually, take 3-4 minutes to think about how you might approach this problem with a visual representation:

Carla's Book

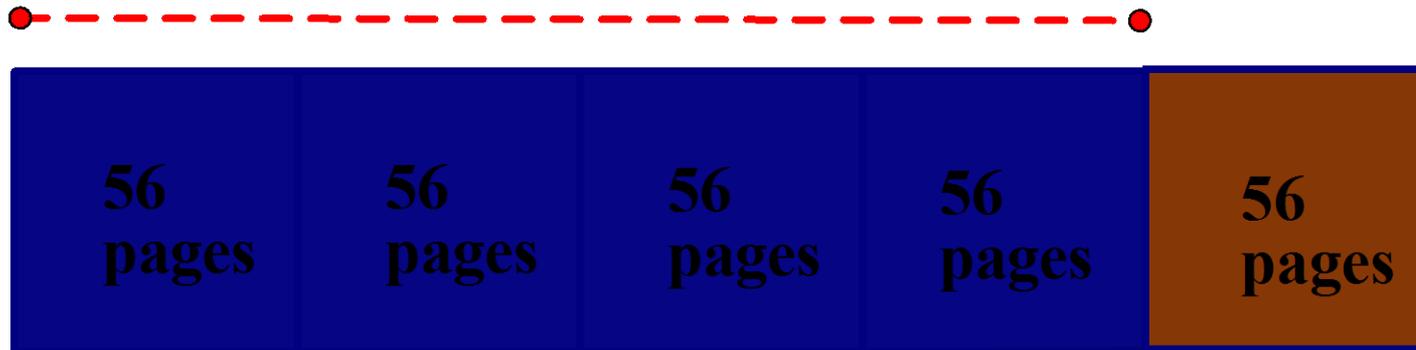
Carla read 224 pages of a book. Carla still has $\frac{1}{5}$ of the book left to read. How many pages are in the book?

Your Turn

- Form pairs.
- Generate a scaffolded worked example for students to analyze (i.e., your own AVR).
 - We provide the end of the example (handout)
 - Fill in the rest (you can alter ending if you wish)
 - Then answer Q2-5 about how use with students

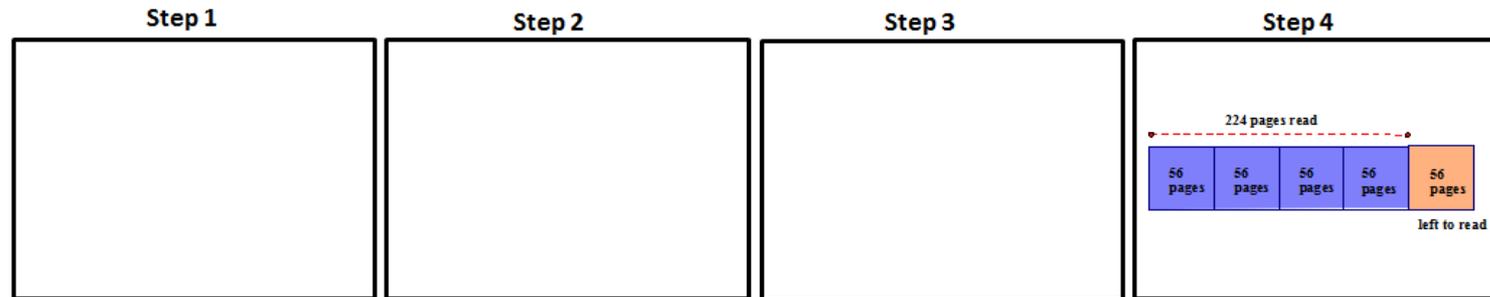
Last step

224 pages read



left to read

Template



List words and phrases that you want students to use while analyzing Carla's diagramming steps. (These might go in an informed word bank.)

What sentence starters would you include on the handout for students to complete while analyzing Carla's diagramming steps?

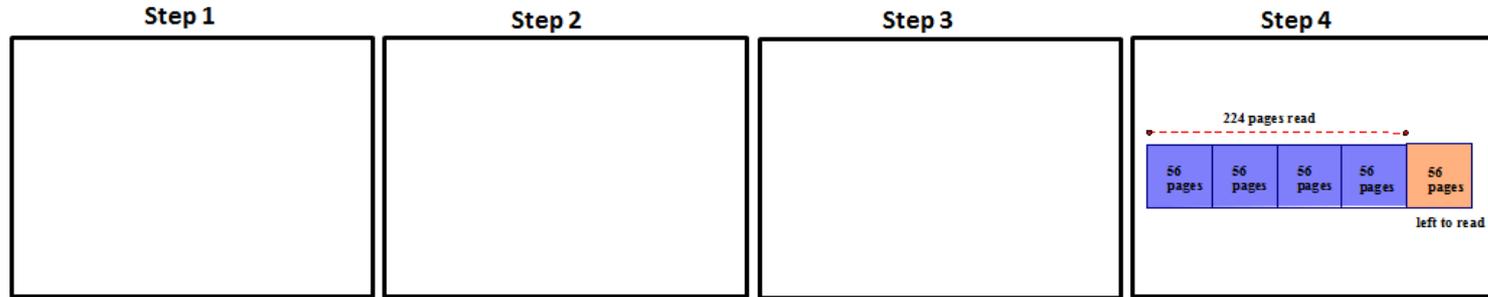
What other language strategies would you use to support access to language or student production of language and how would you use them?

Finally, consider and make notes about questions you would ask students while they were analyzing Carla's diagramming steps.

Your Turn

- Form pairs.
- Generate a scaffolded worked example for students to analyze (i.e., your own AVR).
 - We provide the end of the example (handout)
 - Fill in the rest (you can alter ending if you wish)
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Template



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Our Learnings

To help English Learners learn mathematics:

- Emphasize diagramming as a mathematical *thinking* strategy.
- Integrate support for language access and production.
- Incorporate analysis of diagrams:
 - Sample diagrams could come from fictional students like Estella, other students in the class, or the teacher.
 - Diagrams for analysis could be incomplete or incorrect.

A new website, generated from one of our projects, which we hope will be helpful to you, and which we hope to grow:

mathandlanguage.edc.org

Questions?

Thank you!