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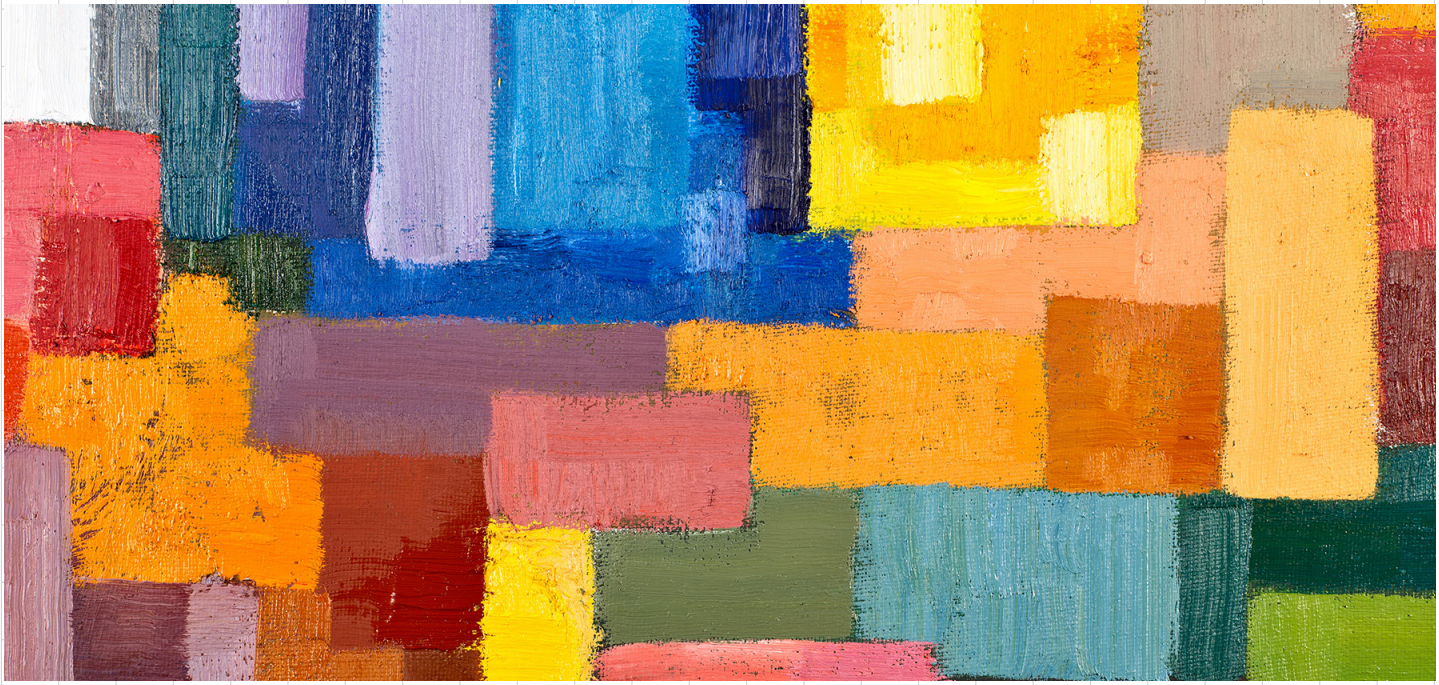

Using Visual Representations: Engaging **all** students with the standards for mathematical practice

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MATHEMATICS EDUCATION GROUP

NSF

Notes

Math Activity 1

Find these and other activities at:

https://resources.corwin.com/mathargumentation

Use these dynamic visual representations to justify the conjecture:

If you make a parallelogram by collapsing a rectangle, then the areas of the parallelogram and the rectangle are the same.

Part 1: https://goo.gl/Wkh6Bw

Part 1: https://goo.gl/iEx8uU

Math Activity 2

Use your own visual representation on paper and pencil or dynamic math representations (GeoGebra) to justify this conjecture:

$a(x + c) = ax + ac$ is true for all x, no matter what a and c are.

https://ggbm.at/ZXDHRgqs

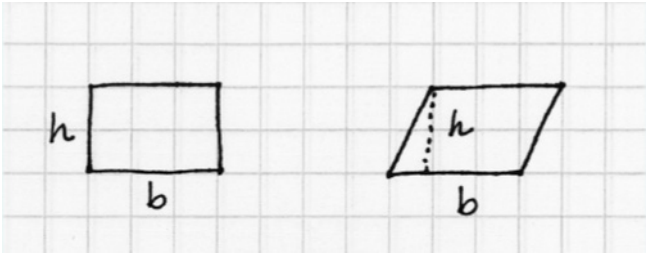
Vignette: ELLs use gestures and diagrams

Participants: Mr. Lima, Fatu, Lena, Tiago, Anika.

Inspired by a conversation with students in the previous class, Mr. Lima posed the following argument to his bilingual students:[1]

> The area of a rectangle and a parallelogram are the same because if you collapse a parallelogram into a rectangle, the area doesn't change.

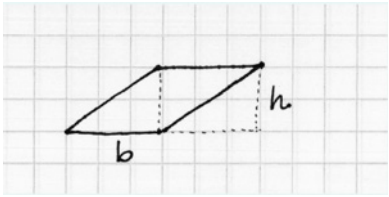
Mr. Lima presented a student argument that was not yet mathematically precise, so that students would have the opportunity to provide refinements to it. After a few minutes in which students worked in pairs, Mr. Lima asked for volunteers and several students offered contradictory responses.

1	**Mr. Lima:**	Let's start with you two, Fatu and Lena.
2	***Fatu:***	The area will be the same.
3	**Mr. Lima:**	Okay. How do you know?
4	**Fatu:**	Because we drew it and the formulas for area are the same.
5	**Mr. Lima:**	Why don't you bring your notebook to the document camera and you can walk us through your logic?
6	**Lena:**	See the, base and the height are the same, so the area is the same. 
7	**Tiago jumped up:**	But this is not what the argument said. It says what will happen as the rectangle flattens.

Inspired by conversation in Lara-Meloy, T., & Barros, A. (2000). Base × height: The transformation of a rectangle. *Hands On!,* 23(2), 4–7.

8	**Fatu:**	Yeah. You can see that the parallelogram is flatter. You can make it really long, and it will still be the same area.

She drew another longish parallelogram with the same height.



9	**Fatu:**	You see the triangle here (pointing to the triangle formed at the left side of the parallelogram), that's the same one as here (pointing to the right of the parallelogram). So, the area stays the same.
10	**Tiago:**	But if a rectangle flattens … it's like a box. If you go all the way, it will have no area.

At this point, Tiago extended his arms and bent them at the elbow, simulating the sides of a rectangle. He then simultaneously pivoted both arms at the elbow until his forearms were making a line and the right hand was touching his left elbow.

With this gesture, Tiago expressed that the sides of the parallelogram were fixed and that flattening a rectangle was more like flattening a box, changing the angle. At this point, Mr. Lima stepped in to help students develop language to express Tiago's idea.

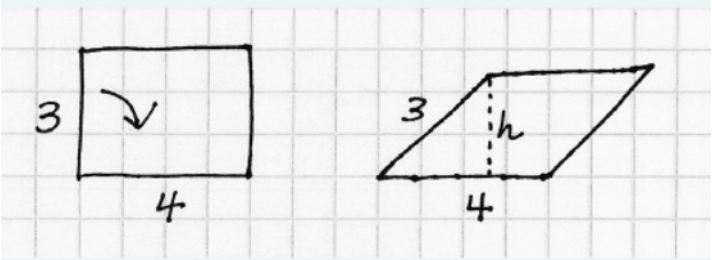
11	**Mr. Lima:**	Do folks understand what Tiago is trying to say?

Some students said yes, but others said no.

12	Mr. Lima:	I want you to take a minute to talk to your partner to discuss what Tiago just said. See if you can make a diagram to help us understand what he said.

After a few minutes, Mr. Lima asked if anyone wanted to explain what Tiago was gesturing in words.

13	Anika:	We agree with Tiago, and we disagree with Fatu and Lena. We made this drawing before, when we were discussing.
14	Mr. Lima:	Remember to explain what Tiago said using his arms.

15	**Anika:**	I was saying that it's the same thing as what we said. If you squoosh a rectangle, the height is getting less, until there's no more height. 
16	**Mr. Lima:**	How does this affect the area?
17	**Anika:**	If there's no more height, then there's no more area.
18	**Mr. Lima:**	Fatu, Lena, what do you think? Are you convinced?
19	Lena:	I think we had a drawing that had the same height in the rec-tangle and the parallelogram. But Tiago is saying that the sides are the same, not the height. If you keep going, and you squoosh it all the way, the height gets smaller, and you end up with the top line of the parallelogram on top of the bottom line, so there is not area.

As this vignette shows, gesture and diagrams can both play an important role in ELLs' participation in argumentation. Tiago's gesture had been critical in helping students understand the conjecture they eventually articulated,

> **As one pair of interior angles of a parallelogram gets smaller, the area of the parallelogram becomes less.**

The gesture had also been part of a justification for it. Mr. Lima had students articulate that gesture and justification in words.

Notes

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