Implementing the Mathematical Practice Standards: Enhancing Teachers' Ability to Support the Common Core State Standards

Project Description

Implementing the Mathematical Practices Standards (IMPS) is a four-year project designing resources to increase educators' awareness and understanding of the mathematical practices as described in the Common Core State Standards (CCSS) for Mathematics. The project will produce Illustrations of the Mathematical Practices (MPs) and a professional development curriculum centered on the use of those Illustrations.

Goals

- Increase educators' (teachers and others) awareness of the MPs
- Support educators' understanding of the MPs
- Cultivate educators' capacity to identify MPs in student thinking
- Develop educators' ability to support student engagement in the MPs

Products

- *Illustrations* for grades 5-10 teachers that include:
  - Dialogue between student characters working on a mathematics task that illustrates the MPs
  - Teacher reflection questions about the dialogue and the MPs
  - A mathematical overview highlighting key mathematical ideas
  - Student discussion questions and classroom mathematics tasks
- *Website*: to facilitate dissemination of the *Illustrations* and collection of public comments on the *Illustrations*
- *Professional Development Curriculum*: centered on use of *Illustrations*

Research Questions

- Does use of the MP Illustrations help build teacher understanding of CCSS MPs?
- What formats for MP Illustrations best promote teachers' understandings of CCSS MPs?
- Do dialogues contribute to teachers' understanding of what makes a good mathematical discussion, or to how they support such discussions in their classrooms?
- What professional development supports for the MP Illustrations best promote teachers' understanding of the CCSS MPs?
- Does participation in the IMPS professional development cultivate educators' capacity to identify CCSS MPs in student thinking and to support student engagement in MPs?

Contact

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Implementing the Mathematical Practice Standards

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Finding Triangle Vertices

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Open Student Dialogue (in its own window)
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Mathematics Task

Two vertices of a triangle are located at (0, 4) and (0, 10). The area of the triangle is 12 units^2. Where is the third vertex located?

Student Dialogue

(1) ***Nicholas***: So why don't we pick a point for the third vertex and see if the triangle has an area of twelve square units. Let's try the point (8,4).

(2) ***Agnes***: Ok, so we will need to use the formula for area of a triangle. That's A = ½ base × height.

(3) ***Nicholas***: So if we count the units on the coordinate plane between the points, we have a base of 8 and a height of 6. Right?

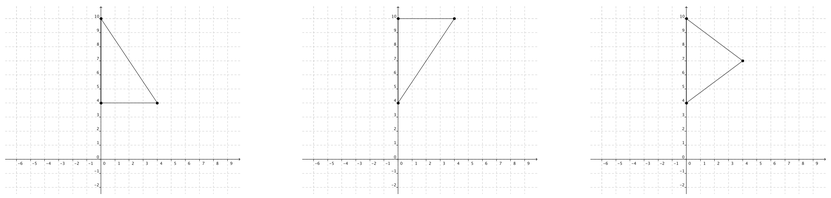
(4) ***Vivienne***: That's right. Or if you turn the coordinate plane around you could say the base is 6 and the height is 8. Either way is fine in this case.

(5) ***Nicholas***: Great, so let's plug our values into the formula. A = (½)(8)(6) = 24 units^2. Hmm I guess we need to pick a different point.

(6) ***Agnes***: Instead of picking a different point, how about we use the formula and work backwards. We know A = ½ base × height. We also know our triangle must have an area of 12 units^2 and we can say the base is equal to 6 units. Using all this information we can find the height. Using the formula we get 12 = (1/2)(6)(*h*). This simplifies to 12 = 3*h*. Solve for *h* and we get *h* = 4.

(7) ***Nicholas***: So that means the height of the triangle is 4. Let's each figure out the third vertex and compare our answers to check.

[*Students work individually for a minute*]



(8) ***Nicholas***: I got the point (4,4).

(9) ***Agnes***: How did you get that? I got (4,10).

(10) ***Vivienne***: And I got (4,7). What did you guys do to get your answer?

(11) ***Nicholas***: Well, it worked! I started here [*he points to vertex (0,4) on his drawing*] and counted over 4 units to get (4,4).

(12) ***Agnes***: I started at (0,10) and counted 4 to get (4,10).

(13) ***Vivienne***: I started in the middle, at (0,7), and moved right 4 to get (4,7).

(14) ***Agnes***: Well all our triangles have areas of twelve so I guess we are all right.

(15) ***Vivienne***: Wait! I think we could count over 4 from any point on the base. So our third vertex could be anywhere between (4,4) and (4,10).

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Standards for 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.

Targeted Standards

Mathematical Practices:
MP 1: Make sense of problems and persevere in solving them.
MP 6: Attend to precision.
MP 8: Look for and express regularity in repeated reasoning.

Mathematical Content:
Grade Level: 6th grade
Content Domain: Geometry
Math Topics: coordinate plane, area of a triangle

Teacher Reflection Questions

- In what ways does the students' thinking illustrate any of the mathematical practice standards?
- Are the students done? Have they found all possible coordinates for the third vertex of the triangle? Explain.
- Suppose that the students in the dialogue were working in three dimensions. Given that two vertices are at (0,4) and (0,10), where could the third vertex of the triangle be located?

Highlights of Mathematical Overview

- Trying different approaches to an open-ended task (MP 1)
- Definition of a triangle base (MP 6)
- Student misconceptions about triangle height
- Expressing regularity in process and results (MP 8)
- Infinitely many solutions
- Relationship between area and perimeter (extension)

Student Discussion Questions

- In line #4, Vivienne said that either side could be called the height. Why is this true?
- If Nicholas had guess and checked another point, which would make more sense for him to try: (10,4) or (6,4)? Explain why without calculating the area of the two possible triangles.
- Are there any other points for the third vertex that the students in the dialogue have not found? How do you know?

Related Mathematics Tasks

- Two vertices of a triangle are located at (-1, -5) and (7, -5). The area of the triangle is 24 units^2. Where is the third vertex located?
- A point is located 5 units away from the point (7,8). Where is the point located?
- Two vertices of a triangle are located at (4,1) and (4,5). The perimeter of the triangle is 12 units. Where is the third vertex located? How many places could it be located?

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