BE THE CHANGE: RE-IGNITE STUDENT’S PASSION FOR PROBLEM SOLVING & MATHEMATICS

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WARM-UP
As you settle in, complete the warm-up by flipping to the backside of your packet and “Quartering the Cross”. This means, you will color one quarter of the cross in one color, and the rest in a second color.
Outcomes!

✓ I will be able to facilitate an open ended and open middle problems in the classroom, complete with questioning techniques and student prompts.

✓ I will experience how to modify a textbook problem into a richer open task that encourages discussion and multiple approaches, with a focus on tailoring them to real world applications.

✓ I will leave with a list of questions, perfect for posing to students while engaged in the problem solving process, and also useful for any class period when students are lacking persistence.
Introductions

Who am I?

Who are you?
Open Middle Problem

A bug is crawling around on the Cartesian plane. It’s initially at the point (-1, 7); and after 2 seconds, it’s at (1, 4). Assuming the bug continues to walk,

How long will the bug be in the first quadrant?

SILENT THINK TIME!
Open Middle Problem

A bug is crawling around on the Cartesian plane. It’s initially at the point (-1, 7); and after 2 seconds, it’s at (1, 4). Assuming the bug continues to walk,

How long will the bug be in the first quadrant?

NOW WORK AS A GROUP!
Open Middle Problem

1. Write a mathematical model that describes the path the bug is traveling on.
2. How far did the bug travel in the second quadrant?
3. Suppose when the bug changes direction when it reaches , and in the direction corresponding to the vector .
   a) How many degrees did the bug turn as it headed in the new direction?
   b) How long is the bug in the first quadrant?
Debrief

- Challenges?
- Successes?
- Observations?
Three Major Findings

1. Tasks are not created equal: they provide different opportunities for student learning and thinking.

2. Tasks that encourage high level thinking and reasoning have the greatest student success. Student success is lowest where tasks are procedural.

3. Tasks with high cognitive demand are the hardest to implement and often are transformed into less demanding tasks during instruction.

Principles to Action, 2014
Open Middle Vs Open Ended

**Open Middle:**
- Start with the same problem
- End with the same answer
- The journey to the solution can have multiple approaches and paths.

(This is where the fun happens in discussing and comparing methods!)

**Open Ended:**
- Start with the same information *(Not necessarily the same problem)*
- End with various solutions
- There are multiple correct answers based on assumptions made by the reader.

(These are harder to use in class discussion as students were all answer different questions.)
1. What is the square root of -16?

2. Using the graph to the right answer the following:
   a. How fast is the ball travelling at 2 seconds?
   b. What is the maximum speed of the ball?
Open Ended Example:

Your family needs to buy a new car and is considering buying the hybrid version if the money saved on gas will be enough to pay the extra cost for the hybrid.

Question:

- How many years will it take from saved gas money to pay for the extra cost for a hybrid?
- Could you ever save enough money on gas (compared to your current car) to pay the entire car payment?
Open Ended Example:

1. Which sport is best represented by the graph to the right?

Why?

Explain what happens at each change in the graph?

Are there any sports that would not work with this graph? Why not?
Open Middle Example

1. The speed and distance of a ball is represented by the graph $y = 4x - x^2$. Represent this visually and show how fast the ball is travelling in seconds (each y value equals 10km/hr).

2. Can we evaluate the square root of -16? Why or why not? If so, explain your method in words and symbolically.

3. Is $x + 3$ a factor of $x^2 - x - 8$? Explain your answer.
**Funneling Vs Focusing**

**Funneling:**
- Guides a student down the teacher’s path to find the answer.
- Limits student thinking: hinting at an answer

**Focusing:**
- Allow students to do the cognitive work of learning by helping to push their thinking forward.
- Encourages students to figure things out for themselves
Examples

Funneling:

- How do you find the mean of the data?
- What about the mean and mode?

Focusing:

- What do you notice about the data?
- How would you describe them to someone?
- What other ways might you be able to describe them?
More Examples

Funneling:

- How can I get rid of the 2?
- What do I have to do to the other side?
- What about the 4?

Focusing:

- What do you think about when you see this equation?
- How do you want to solve it?
**Aggressive Monitoring**

**Monitor Aggressively:** Check students’ independent work to determine whether they’re learning what you’re teaching

1. Create & implement a monitoring pathway:
   - Create a seating chart to monitor students most effectively
   - Monitor the fastest writers first, then the students who need more support

2. Monitor the quality of student work:
   - Check answers against your exemplar
   - Track correct and incorrect answers to class questions

3. Pen in hand:
   - Mark up student work as you circulate
   - Use a coding system to affirm correct answers
   - Cue students to revise answers using minimal verbal intervention
Addressing typical “Textbook Problems”

1. What is the square root of -16?

2. Using the graph to the right answer the following:
   a. How fast is the ball travelling at 2 seconds?
   b. What is the maximum speed of the ball?
Thoughts on Rigor

Potential of a Task vs Implementation of a task
Group Brainstorm: Open Middle Prompt

Questions to Answer: (Individually - 5 minutes)

1. Write 3 funneled questions
2. Write 3 focused questions
   (As a Group)

3. Discuss when it is appropriate to use funneled over focused?
Now Create your own!
Resources


• Open Middle http://www.openmiddle.com/