What was She Thinking? How Did He Get That? Using Writing to Reflect, Advance and Deepen Learning

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Overview of Session

Use writing to:

- Assess students' disposition
- Know more about your students' mathematical background
- Improve vocabulary
- Enhance communication
- Evaluate concepts
- Deepen and assess learning

Try These with me

Write the first word that comes to mind.

- If math were a food, what kind of food would it be?
- If math were weather, what type of weather would it be?
- If math were a building what kind of building would it be?
- If math were an animal, what animal would it be?

Why? Write a sentence. If math were _____ it would be _____ because _____.

Learning more about your students and their relationship with mathematics.

Gathering Valuable Information

- What do you like for a teacher to do in math class? How can a math teacher be helpful?
- What do you hate for a math teacher to do? Is there something I need to know about teaching math?
- One time in math class... Complete the sentence, telling me something that happened and how you felt about it.
- Tell me something about yourself that I don't know that I need to know.

Mathematical Autobiography

- What year in school was math the best for you? What made it a good year in terms of math?
- What year in school was math one of the worst for you? What made it a bad year in terms of math?
- Think about mathematics and describe a concept or skill that you can do well.

The day will come, I believe, when the value of writing to learn will be universally acknowledged.

Reuben Hersh

"A Mathematician's Perspective"

Writing to Learn Mathematics and Science

Learning mathematics is more than simply copying what the teachers does and repeating it. Students must learn mathematics in many different ways. Writing provides the time for students to think and reflect, to make meaning about what the are learning. By writing they begin to make an idea or concept their own.

Construct viable arguments and critique the reasoning of others.

Writing provides another way to help students explain and allows others an opportunity to evaluate their reasoning. They justify their conclusions, communicate them to others, and respond to the arguments of others

Writing to Enhance Classroom Routines

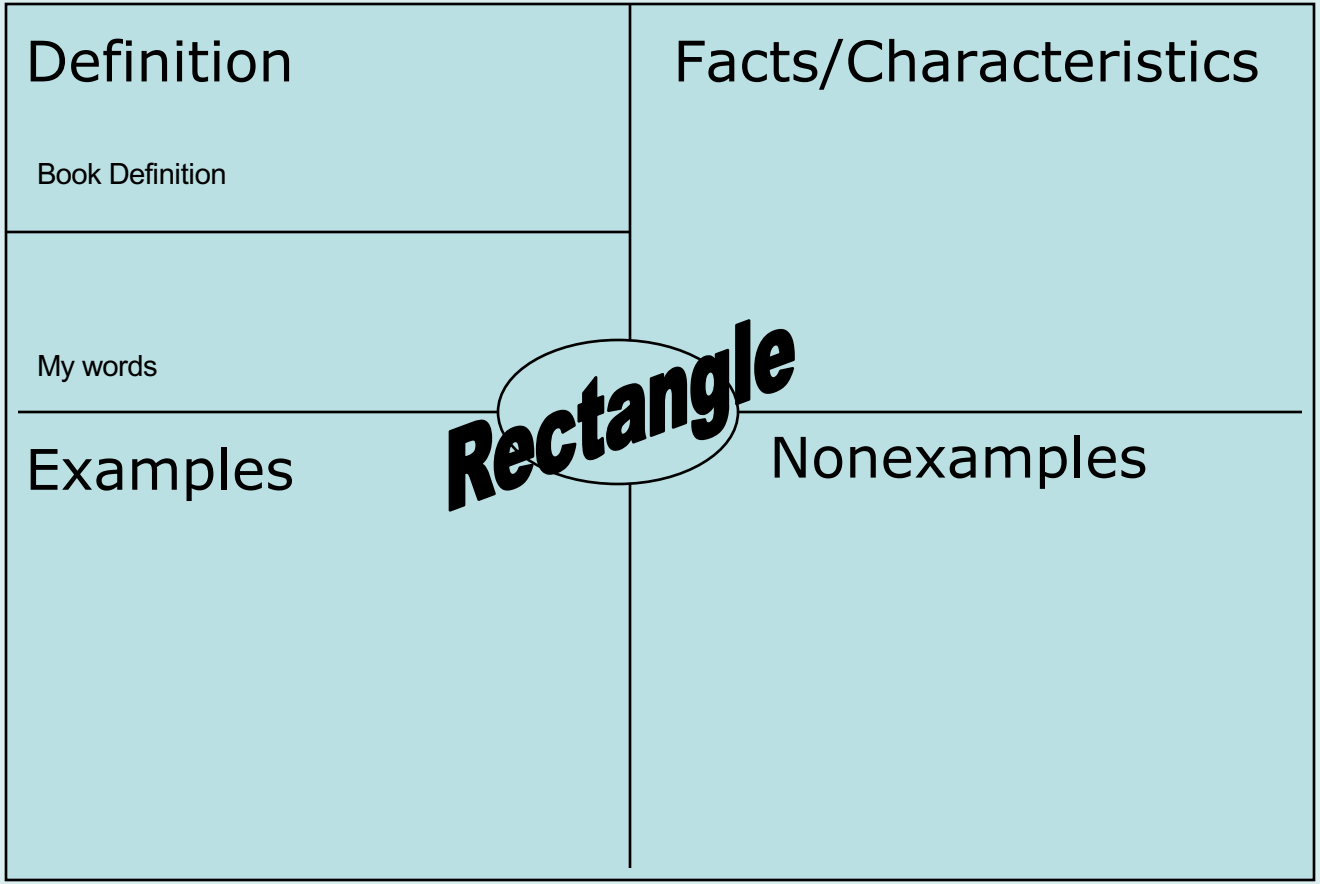
Write
Pair Share
Write
Discuss

How could writing using this technique help students understand more and increase classroom dialog?

Vocabulary

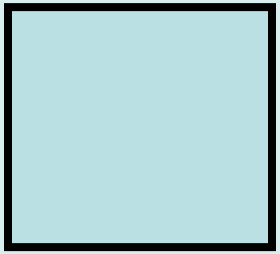
- A critical component needed for learning mathematics is a complete understanding of the language of mathematics.
- Learning new mathematics is built upon previous information and knowledge. The earlier a student acquires mastery of the vocabulary the more success they will achieve.
- Review vocabulary before asking students to do a writing activity. Provide key words where they can see them.

Modified Frayer Model



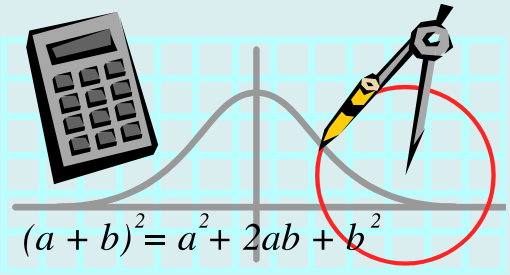
What do you picture in your mind when someone says RECTANGLE?

- If you only see a square, are you missing part of the concept?
- If you see rectangles that do not include squares you also miss part of the concept.



Mathematics is a subset of the English language.

- New terms, multiple definitions and confusion on the students' part contribute to their writing trouble.
- More confusion comes with use of symbols and their meanings.
- Dealing with mathematics is not simply dealing with numbers and language contributes to the difficulties ELL learners have with math.



What are some of the dual meaning words we use in Algebra?

- The teacher was _____.
- The _____ of 3,4,5,6,7 is 5.
- The woman wearing a coat in summer is _____
- 7, 13 and 29 are all _____ numbers.

Did you need both sentences to figure out the meaning? Which helped you more? Create your own.

G is for Googol A Math Alphabet Book
by David M. Schwartz

D is for Diamond

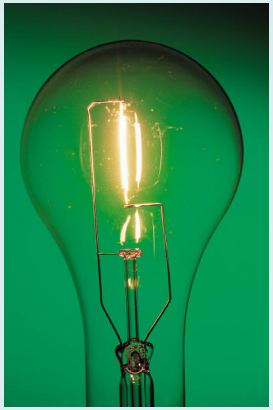
"Diamond shouldn't be in this book. There are diamonds in rings and there are diamonds on baseball fields, but there are no diamonds in math. If you take a square and tilt it on one vertex you squeeze it a little so it becomes pointier at two ends and less pointy at the other two ends, it's not a square anymore. But it isn't a diamond, either. It's a rhombus."

Write your own Mathematical Alphabet Book

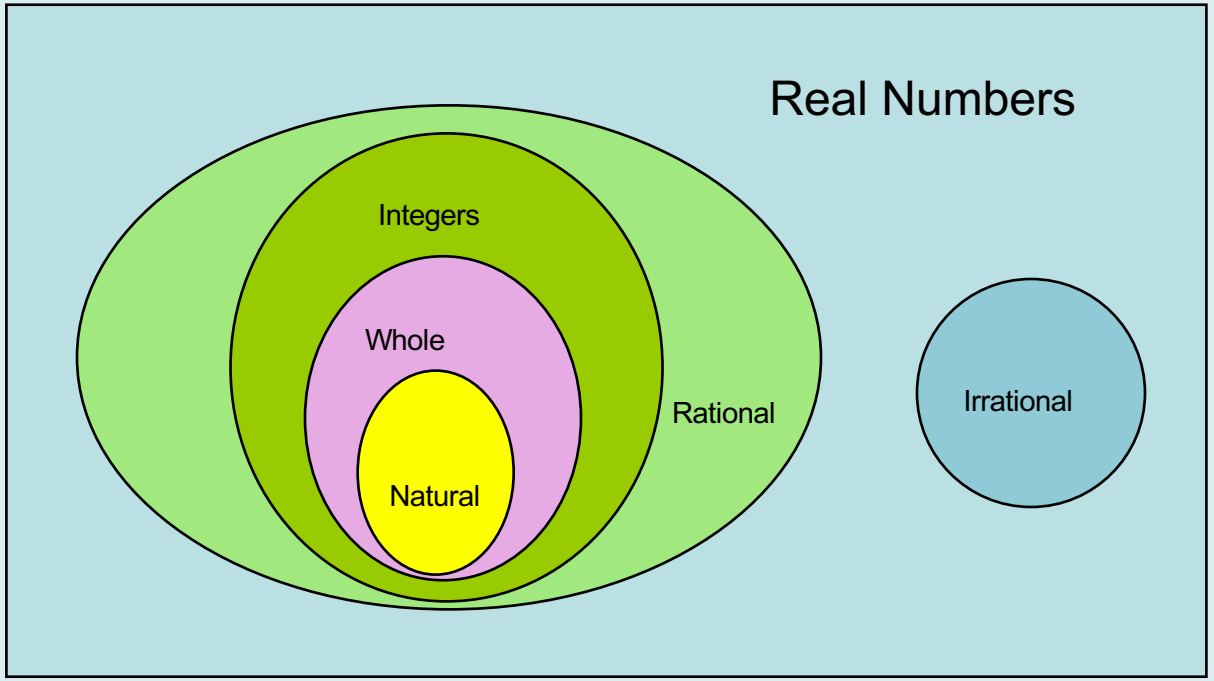
- Ask students to select another D math word and with a partner begin to write your page for a class book.
- Other D words:

  data, decimal point, decimal system, degree, denominator, density, diameter and dodecahedron

Writing allows the brain time to reflect on learning. **Thinking time** is necessary to process learning. It is **more valuable to students than memorization.** When thinking about the concept or idea the student can go back to the way they have created meaning during their writing.



A Venn Diagram of the Real Number System



What do you notice and wonder about this diagram?

A Sample Story

A bird watcher went out one day and spotted three meadowlarks. (natural) The next day she did not spot

Creating a story helps students remember.

day she went with another friend and they both spotted the same bird so they each recorded one half of a sighting. (rational) When spotting the last bird sitting in a tree they argued about the circumference of the tree. (irrational)

Benefits of Writing in Mathematics

"Adding this kinesthetic activity (writing) engages more neurons and causes students to organize their thoughts about the concept."

David A. Sousa in *How the Brain Learns Mathematics*

- Students create a record of their thoughts where they can return to reflect on them.
- Students become active participants in their own learning by engaging with mathematics.

- Students establish a personal connection to new mathematics concepts.
- Through writing students learn that there is not just one right way to do mathematics and that multiple approaches will be valued.
- Students learn to examine partially formed ideas and to enhance communication.

Journal Writing

- A journal is a place where students can answer questions and begin to find a way to create meaning about mathematics.
- Students can use their journal to ask questions, communicate about mathematics, write to and for themselves about mathematics.

Journal Entries

- Which number is greater -34 or -45, explain why.
- Write a note to next year's class which explains the difference between the area and perimeter of a square in your own words.
- Describe a real life situation where you would need to measure an angle.
- Do .2 and .02 equal the same fraction? Explain your answer.

Benefits of Journal Writing

- Help students form views about mathematics.
- Better student-teacher interaction. A way to better understand your students.
- Improve writing skills.
- Individual diagnosis and evaluation.
- Help students think about the nature of mathematics, mathematics is more than memorization of rules and procedures.
- Give weak mathematics' students a chance to use a skill area in which they may excel.
- Help students to make connections between topics.

Student Directions for Journals

- Get your journal out and being to write when you enter the classroom.
- Write in complete sentences.
- You are responsible for missed journal entries.
- Ask questions to which you would like a response.
- Date each entry. Use a specific folder for your journal. (no spiral notebooks)

Critical Points

- Time
- Grading Policies
- Respond to writing efforts
- Ideas to make them easier to manage
  - Use paper notebooks with limited paper
  - Vary the types of writing
  - Vary the length of responses needed

How can you make journal writing easier?

- The main thing I learned was. . .
- The concepts introduced were. . .
- The new words that were defined are…
- I had the most trouble with . . . because. . .
- I learned that I . . .
- I discovered that . . .

Use writing to help students do a better job on tests

Questions for Test Taking

Before the test:

- How did I prepare for it?

After the test, but before the test is handed back:

- How well do I feel I did on the test?

After the test is handed back:

- Take two specific errors. For each, reconstruct how you thought about that problem.

How can you help students' value writing?

- Put one or two questions on each test. Students learn to value what we assess.
- Make a bulletin board out of their writing.
- Place selected entries in their portfolios.
- Use praise and positive reinforcement when you respond to their writing.
- Give examples of occupations which use technical writing.
- Ask them to read books or articles which deal with mathematics.
- Read out loud to your students about mathematics.

Writing about Mathematical Concepts

- It is difficult for students to move on in mathematics if they do not have a complete understanding of the basic concept.
- Writing about the concept can help the student internalize the idea.

Dealing with Data (measures of central tendency)

- Describe a situation where the mode would best represent the data. Create an example of a set of numbers.
- Where would you use the median to represent your data. Explain why it would be better.

RAFT Role/Audience/Format/Topic

- Another writing-to-learn activity to enhance the understanding of information.
- Role: Reporter, observer, eyewitness, object
- Audience: Who, teacher, parent, students, editor, customer, jury,
- Format: poem, advertisement, letter, article, report, petition, tip sheet, diary, directions for a blueprint, advice column
- Topic: mathematician, procedure, lesson, skill

RAFT

R	A	F	T
Zero	Whole #’s	Campaign Speech	Importance of # 0
Exponent	Jury	Instructions to the jury	Laws of exponents
Variable	Self	Diary	How to solve a linear equation

Learning the meaning of Symbols

Explain the = sign. What does it mean? Show me two different ways to use it correctly. Show me one way to use it incorrectly.

Using Writing in Assessment

- Writing provides a record of students' thoughts, it demonstrates progress in learning.
- It can you help you diagnose errors, provide insight into what must be retaught, and provide evidence of connections made or failed.

Solve the following problems three ways

- Mathematically
- In words - Tell why!
- With pictures or shapes

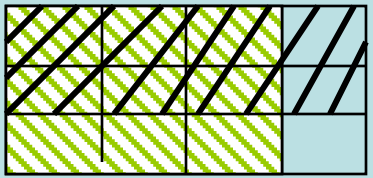
$$\frac{2}{3} \cdot \frac{3}{4}$$

$$\frac{2}{3} \bullet \frac{3}{4}$$

Mathematically

$$\frac{2}{3} \bullet \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$$

Pictures or Diagrams



In words - explain

Vertically the box is divided into fourths and we shade 3 of them. Horizontally divide into 3 parts and shade 2. So we are taking two thirds of the three fourths and the overlap is 6 out of 12 squares or ½.

(x+3)(x+1)

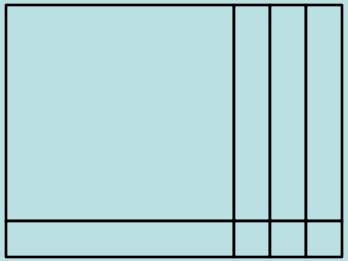
Mathematically

$x(x+1) + 3(x+1) =$

$x^2 + x + 3x + 3 =$

$x^2 + 4x + 3$

Diagram



In Words

The horizontal axis is x+3 and the vertical is x+1. When x is multiplied times x you get x^2 and 1 times x is x. You have 4 of those and 1 times 1 is 1 and you have 3.

So much is expected from the teacher and the learners there is limited time to re-teach.

The time you take to write provides your students the time to learn. Their brains need time to process the large amount of information they receive. Use the writing they provide to record and enhance their learning. Writing helps students demonstrate the mathematics practices.