Getting Started

Take a few minutes to jot down your thoughts about the following two questions:

- What do you hope to accomplish by using writing as part of your instruction?
- What are your major concerns in using writing to teach math?

Objectives

- Think about why writing may be effective for learning
- Get many examples of writing assignments and how they align with different objectives
- Start to create your own writing assignments targeting specific goals

What different types of learning might result?

- Solve $5n + 2 = 17$.
- Solve $5n + 2 = 17$. For each step, explain your process clearly so a classmate who wasn’t in school today would understand what you are doing and why it makes sense.
- Solve $5n + 2 = 17$ in at least two different ways. Which way is easier for you? Why?

Why Use Writing? Assessment

- Find out what students know about concepts
  - For grading
  - To inform instruction
- Discover student attitudes & beliefs
- Determine if instruction was effective

Why Use Writing? Attitudes & Beliefs

- Encourage student-teacher communication
- Promote positive attitudes toward math class and mathematics
  - Variety, different modes to show knowledge
- Provide assignments that imply different beliefs about mathematics
  - Multiple methods, ability to reason & communicate, need for perseverance, proof as convincing others
Why Use Writing?
Attitudes & Beliefs
Example:
We know that if we divide by a fraction, this is the same as multiplying by its reciprocal. But why does this make sense? Give an example of a situation that involves dividing by a fraction, work out the example, and try to explain why the rule about multiplying by the reciprocal makes sense.

Why Use Writing?
Student Self-Evaluation
• Reflect on study habits
• Set goals
• Metacognition
  - Example: Test Corrections
    Explain in words what you did incorrectly...

Why Use Writing?
Learning Content
• Uniqueness of Writing as a mode of communication
  - Permanence of record
  - Expressive & creative unlike listening or reading
  - Does not have the context of speech, so it is necessary to be more explicit & precise
  - Takes more time to accomplish, so more time to process and reflect on ideas
  - Use of multiple senses/tactile

Why Use Writing?
Learning Content
• Externalization of Thought
  - Students can discover what they think as they write, leading to more fruitful discussion
  - Written work externalizes a form of thought so that it can be manipulated

Why Use Writing?
Learning Content
• Increasing Memory
  - Attention can be increased by involving emotion (interaction, positive attitudes) and developing meaning
  - Consolidation: need to have time to process the idea
  - Rehearsal: repeating the material in ways that increase meaning or relevance; the more manipulation of the material, the greater likelihood it will be remembered

Why Use Writing?
Learning Principles
• Multiple Intelligences
  - Linguistic
  - Kinesthetic
  - Spatial (if use diagrams)
  - Intrapersonal (metacognition)
  - Interpersonal (discussion, peer reading, etc.)
Why Use Writing?

Connections

- Within mathematics
- Beyond mathematics
  - To other school subjects
  - To areas beyond the curriculum: careers, leisure activities, etc.

Examples:

- Concept Map
- Who Uses Math?

Students are given an item and need to think of a career where it is used. Students think of three different ways that mathematics is used in that career. Then students are expected to interview an adult and write a paragraph telling about that person’s job and three ways that mathematics is used in that job. Students are encouraged to use examples as much as possible.

(Patterson)

Why Use Writing?

Mandates

- NCTM and NYS Communication Standards
- Tests now require students to explain their work in writing, so students need practice.
- We are told to teach writing and reading in all subject areas

Why do the differences matter?

- Solve $5n + 2 = 17$.
- Solve $5n + 2 = 17$. For each step, explain your process clearly so a classmate who wasn’t in school today would understand what you are doing and why it makes sense.
- Solve $5n + 2 = 17$ in at least two different ways. Which way is easier for you? Why?

Why Use Writing?

Results

- Clarke, Waywood & Stephens (1993)
  - Depth of reasoning in expository journals was predicted better by experience with a journal than by age.
- Ehrich (1991)
  - Confirms & deepens understanding even after a solution
- Borasi & Rose (1989)
  - Systematic analysis of student journal writing found an increase in content knowledge and better student-teacher relationships with college students

Analyzing Assignments

In pairs or threes, look at one of the sets of related assignments you were given. What instructional goals do you think the different assignments might meet?
Variations in Assignments

- Some variations in assignments seem like they may be linked to specific goals. We can learn to use these wisely to target the objectives we have in mind!

Disclaimer: Very few variations in writing have been researched to show their effectiveness!

Development of a classification

- Based on 52 actual assignments from 14 teachers who use them
  - Grade 6-community college
  - Different content areas
  - Different areas of country/student populations
  - Different levels of experience
- Assignments collected and analyzed in conversation with teachers

Results of Analysis

- 49 categories with subcategories and instances
- Three main groupings:
  - Teacher intentions and goals
  - Assignment Specifications
  - Response and Assessment

Tools to Use the Classification

- Detailed categories and instances
- Explanation of the categories, literature basis and samples from the collected tasks
- Questionnaire for analyzing tasks

Example: Availability to Students (3.1.5)

Detailed Category and Instances

- Discarded by teacher
- Kept at discretion of student
- Compiled
  - By student
  - By teacher
- Compiled with reflection
  - By student
  - By teacher

Samples

- Class Summary (Rosenberg)
- Bingo Sentences (Vertuno)
- Student Notebooks (Adams)
- Portfolios (Cabral)
- Problems of the Week (Stofferan)
Example: Availability to Students (3.1.5)

**Questionnaire**
- Intended to allow users to categorize assignments
- Questions lead to the numbered categories
- Can also be used to make choices about how to design an assignment

Using the Classification

My hope is that you will be able to use the classification to
- Get ideas for writing assignments
- Use the wide variety of choices to be intentional in how you use writing

You can find the complete resulting thesis and categories on-line at [www.math.cornell.edu/~kacam/thesis.html](http://www.math.cornell.edu/~kacam/thesis.html)

Variations in Assignments

- Audience
- Revision
- Interaction with other forms of Communication
  - Peer reading
  - Discussion - small group or whole class
- Student choice

Variations in Assignments

- To grade or not to grade?
- What type of grade?
  - Completion
  - Rubrics
  - Comments
- Collection & Availability of Assignment

A General Rubric

Students are given a score from 1 to 4:
- 1: there is no evidence of understanding
- 2: some work, but not able to articulate the idea; the student gets the big picture, but the ideas need refinement;
- 3: everything asked is answered and understood - 100%;
- 4: exceptional - requires significant understanding or application beyond that required. (almost never given)

(Vertuno)

Organizational Structures

- Weekly assignment
- Notebook for daily or frequent use
- One assignment per unit
- One assignment at a time
Analyzing Assignments

Pick one of the instructional goals for one of the assignments you looked at earlier. Determine how you would need to assess the assignment to make sure this goal is met.

Creating Assignments

• Pick a math topic – perhaps what you plan to teach next week
• Determine what you want student to accomplish (you can use the intentions list)
• Look at sample assignments that have similar intentions
• Write your own assignment! (Consider grading & collection as part of this.)
• Share it with a colleague

Ideas for Creating Assignments

Base it on a NYS Content Standard:
• 6.N.8 Distinguish the difference between rate and ratio
• Explain in words what a rate is and what a ratio is, giving examples of each. Compare the two ideas, explaining how they are similar and how they are different. How can you make sure not to get the two confused?

Ideas for Creating Assignments

• Adapt a project in the curriculum
• Find an area that students frequently don’t understand and a creative way to address it
• Adapt some of the assignments in the handout

BE INTENTIONAL!