

## Writing Activities to Conceptualize Math Concepts

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### Abstract

*Students often express frustrations and negative feelings about math (Ruffins, 2007). The purpose of this chapter was to describe several writing activities that can be used during math instruction to help students gain a greater understanding of mathematical concepts. By doing so, students will recognize how math is all around them, and they will learn how to use their new skills authentically. The strategies in this chapter draw upon constructivist pedagogical understandings and describe three specific write-to-learn exercises for math concepts taught at the middle school level. These strategies also provide a model for teachers and preservice teachers regarding effective ways to enhance literacy by integrating brief writing experiences into math instruction.*

**Keywords:** writing, mathematics, middle schools, writing-to-learn

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Teaching students to make meaning from the processes associated with mathematics can be challenging for even the best teachers. One effective strategy to help students increase their conceptual understandings and make math more meaningful is the use of write-to-learn activities designed to help students focus on what they have learned (Baxter, Woodward, & Olson, 2005; Bryant, Lape, & Schaefer, 2014, Zinsser, 1988). Writing activities help students reflect on the purpose of each step in solving a problem, deepen their understanding (Borasi & Rose, 1989; Boscolo & Mason, 2001; Newell, 2006), and gain greater meaning (McCormick, 2010). Zinsser (1988) explained that citizenship involves being an effective writer. In order to reach this outcome, all teachers, not just English teachers, should be responsible for teaching students to write.

In a concentrated effort to improve mathematics instruction, The National Council of Teachers of Mathematics (NCTM, 2000) provided guidance via a published document entitled *Principles and Standards for School Mathematics*. This document outlined college and career readiness standards and corresponding critical elements of an effective PreK-12th grade mathematics program. NCTM also identified five content standards and five process standards for creating a high-quality math program. Communication is one of the essential process standards and elaborates on the need for students to gain the ability to write coherent mathematical explanations. Students are empowered when they articulate how they arrived at a mathematical answer and discover questions that arise during the thinking process.

According to Burns (2004), teachers have the responsibility of providing

opportunities for students to engage in problem solving and reflect on critical thinking processes (Brown, 2016; McCormick, 2010). In addition, engaging ESL learners in writing activities to process mathematics improves their literacy overall (Spack, 1988). Quality literacy instruction transcends all academic content and enhances the lives of all citizens.

The purpose of this chapter is to describe writing strategies intended to increase students' conceptual understanding of math and promote literacy in mathematics education. Skills and knowledge are the building blocks of mathematics. However, through writing, students have the ability to demonstrate a greater depth of knowledge so they can be productive in the workplace and further their education. Furthermore, by using student-writing samples as formative assessments, teachers can ascertain the degree of mastery each student has attained.

### Writing Activities in Mathematics

#### Activity #1- Triangles: The Angles Sum It Up

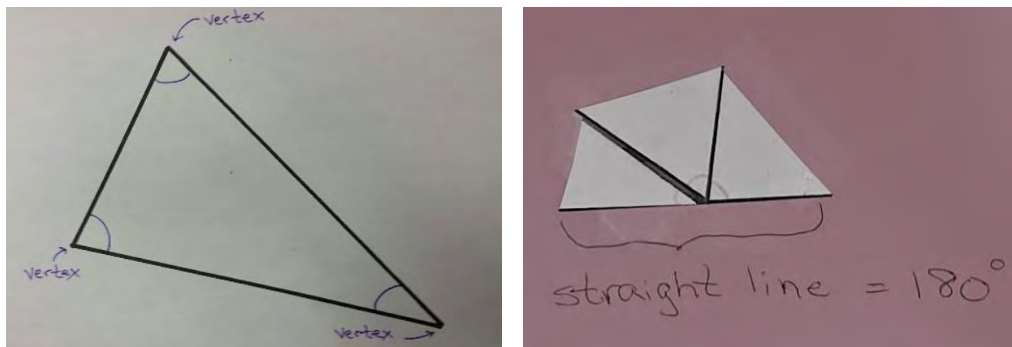
**Objective:** The learner will prove the sum of the angles of a triangle by forming a straight line.

**Materials:**

- paper triangles
- scissors
- scotch tape
- blank paper

**Directions:** Have the students follow along as the teacher demonstrates step-by-step how to cut off the three vertices of the triangle and tape the vertices near the top of the blank paper. All of the vertices should touch tips at the same point with the sides of the former triangle touching one another. Notice arrangement of the vertices touching each other at a single point, with adjacent sides touching, forms a straight line (see Figure 1).

**Student Writing Prompt:** Below the figure, draw an illustration and explain how the sum of the angles (vertices) of a triangle forms a straight line. Remember that a straight line measures 180 degrees.



*Figure 1.* This student work sample illustrates how to cut off the vertices and place them adjacent to one another to form a straight line demonstrating the sum of the vertices is 180 degrees.

## Activity #2 - Who Knew There was So Much to a Cube

Objective: The learner will make a foldable defining the positions and parts of a cube.

Materials:

- cube nets
- scissors
- scotch tape
- blank sheet of paper

Directions: Each student cuts the cube net along the solid lines and folds each square inwards along the dotted lines (see Figure 2). Next, tape the touching sides to form a paper cube. After students construct their paper cubes, identify the three-dimensional geometric shape as a cube and explains its parts: face, edge, and vertex. In small

groups, have students discuss where they see or experience cubes in their environment. Students may also discuss the importance of having a common vocabulary to communicate effectively.

Student Writing Activity: Students will create a foldable for vocabulary words relevant to a cube: cube, face, edge, and vertex. Each student holds their paper portrait-style and folds their paper in half vertically (see Figure 3). While the holding their folded paper, students make four horizontal cuts on the top flap of their paper to create four equally-sized sections. Starting from the top flap, students label their foldable with one vocabulary word per flap (i.e., cube, face, edge, and vertex). Using their three-dimensional paper cube as a visual aid, students explain in writing the position and respective vocabulary word on the inside of the labeled flap.

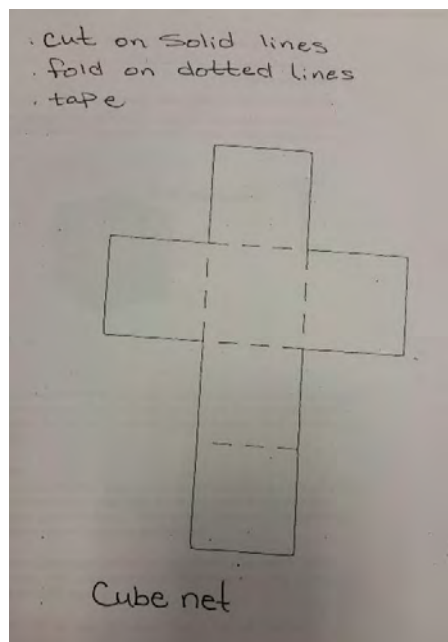


Figure 2. This student work sample shows the original cube net and the final paper cube.

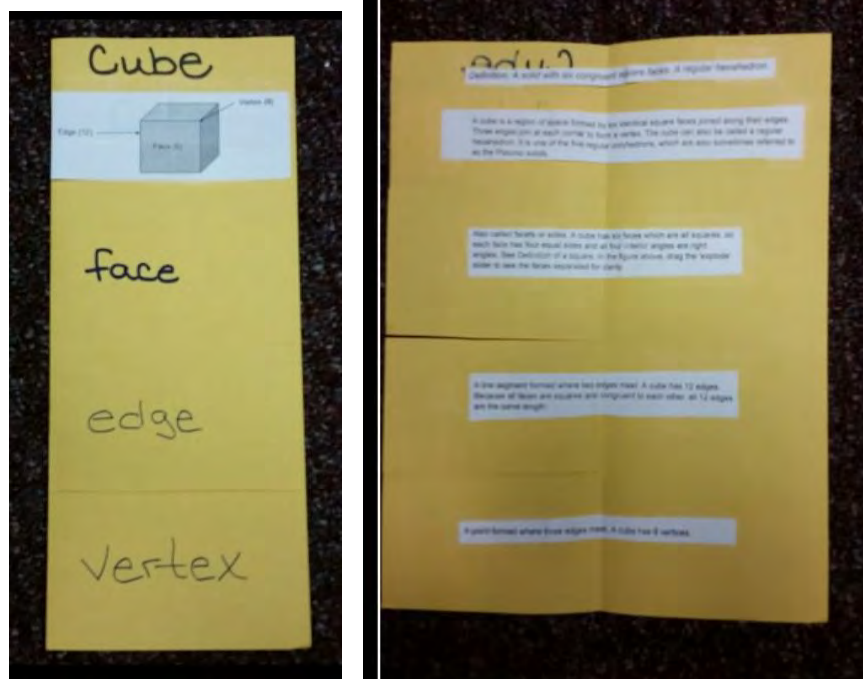


Figure 3. This foldable is a sample of the outside and inside of a student's finished product.

This writing activity is designed to have students reflect on what they have learned about cubes. Each student's foldable also provides the teacher with an informal, formative assessment to ascertain what knowledge the student retained and the complexity of student thinking. Furthermore, the vocabulary transfers to other three-dimensional geometric shapes, which accelerates future learning.

### Activity #3 - Secret Agent Spy Notes

**Objective:** The learner will investigate how to move an index card the greatest distance using only a drinking straw.

**Materials:**

- 3" by 5" index cards
- scotch tape
- drinking straws

**Directions:** Tell students to pretend they are secret agents. As secret agents, they need to discretely pass a secret message to another agent using only a straw. Have students first write a secret message on an index card using a pen or pencil. Then, give each student one straw and instruct them to use only the straw to deliver their secret message to another agent. Provide students with sufficient time to explore a variety of ways to move the index card the furthest distance using only their straw. Expect a wide variety of imaginative, resourceful ideas. While circulating the room and monitoring students, promote effort, persistence, and creativity. Avoid too many tips or hints in order to encourage student exploration and problem-solving, as well as their development of tenacity and grit.

**Student Writing Prompt:** On an index card, explain in writing what you learned during this activity. Describe what you would do differently if you completed this activity again.

### **Writing Prompts for Mathematics**

Write-to-learn opportunities increase comprehension and application abilities in the content areas (Zinsser, 1988). During the writing process, students reflect on what they learned, make connections to their life experiences, and recognize how they increased their understanding of new skills or knowledge (Bangert-Drowns, Hurley, & Wilkinson, 2016). Different prompts encourage different types of thinking and responses.

The prompts for the write-to-learn exercises described in this chapter are for impromptu in-class writing activities. Although these write-to-learn exercises were intended for middle school students, they may be modified for students at any level. These writing prompts should engage students for approximately five minutes and solicit thinking directly after a lesson or learning activity.

While writing, students use a variety of cognitive processes to demonstrate their understandings. Teachers may use written responses to gain feedback about their learning, including difficulties, connections, reflections, feelings, or thoughts about the material. Teachers can also solicit written responses regarding the instructional methodology employed during the lesson.

Below are a variety of writing prompts that foster students' metacognition of new material, their learning, and insights about class activities. Some of the prompts require students to identify their emotional response towards a

new concept or identify something they learning that they did not previously know. Other prompts assist students with internalizing the lesson's learning objective; reflect on new material, instruction, or struggles; make connections to prior knowledge or everyday life; and describe what they liked, found interesting, or questions they have about the lesson. This list is not exhaustive but provides ways teachers and preservice teachers may "prime the pump" for student learning.

### Writing Prompts

1. What is one thing you learned today that you did not know before?
2. If you were to explain this concept to a friend, what would you say?
3. What was the muddiest point of today's work?
4. In your journal, write an entry explaining...
5. What connections did you make between today's math work and your community?
6. How can you use what you learned today in your daily activities?
7. What did you like most about what you learned today?
8. How has writing in your math journal helped you have a greater understanding of the math you are learning?
9. What questions do you still have after today's lesson or as a result of what you learned?
10. If someone asked you what you learned in math today, how would you answer?
11. Reflecting on what we learned in class today, what would you like to know more about?
12. What surprised you about the math we learned today in class?
13. Explain the meaning today's concept (e.g. finding the average, reading a bar graph, counting the value of coins).

14. What do you like most about our math class?
15. What would you like improved about our math class?

### Conclusion

Students may view mathematics as a set of rules, formulas, and magic tricks dispensed by the teacher. However, teachers must move students towards becoming critical thinkers who use higher-order thinking to solve problems. One way that teachers make this shift is through the use of write-to-learn activities. Through

writing, math instruction becomes more than predetermined calculations that converge into a right answer; it becomes authentic. In order for students to gain a deeper, more complex understanding of mathematics, teachers need to incorporate writing activities as an integral part of a math class. Writing facilitates students' thinking processes and cultivates better communication skills. Paving the road and removing roadblocks to math involves linking write-to-learn experiences with mathematics among all learners.

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