Teaching Math Classically
with Andrew Elizalde

Lesson 10: Rhetoric in Mathematics Classrooms

Outline:

In *Rhetoric* (c. 350 BC), Aristotle says: "Rhetoric may be defined as the faculty of observing, in any given case, the available means of persuasion. Rhetoric we look upon as the power of observing the means of persuasion on almost any subject presented to us. And that is why we say that in its technical character, it is not concerned with any special or definite class of subjects."

- Rhetoric, then, should be a regular part of all of our classes and across all ages.

In Andrew's classroom, there is a lot of whiteboard space. When a student comes into the classroom, likely his or her name will be beside a problem. The whiteboard will be filled with names next to problems, and students will be expected to be able to show their work well on any problem.

- This makes up a "gallery of student work."
- Together the class considers the work.
- Students can also explain orally if other students are still confused about their work.
- Students may be brought to understand that their arguments are not clear and need improvement, even if the answer is correct.
- The teacher can ask students also to make connections with common elements or solutions, or to make generalizations—which are the observations mathematicians make.

Can this be done in lower grade levels? Yes.

- Ask students to explain how they did their work to their classmates.
- Ask students to "nominate" another student whose work they liked and say why.
    - Students might like the illustrations that go with the work.
    - They might be persuaded by the student's success in the past.
    - Students are thus assessing the eloquence or persuasiveness of other students' arguments.

- Look for opportunities to show problems where multiple approaches can be taken to lead to correct solutions. Is one more aesthetically pleasing (or beautiful) than another?

<u>Whiteboard exercise (time stamp 12:00)</u>

- **The Chicken and Cow Problem**
    - A break in the fencing allows the cows and chickens in a corral to escape. You aren't sure how many cows or how many chickens got out, but there were 26 animals and 76 legs altogether. How many of the animals were cows, and how many were chickens?
    - How do we approach this? What grade level is the problem appropriate for?
    - **The first approach** is the most common. (time stamp 14:30)
        - x = the number of cows $26–x$ = the number of chickens
        - Because cows have four legs, we'll use $4x$ in the equation. Chickens have two, so $2(26–x)$. There are 76 total legs. Therefore $4x + 2(26-x) = 76$
            - $4x + 52 – 2x = 76$
            - $2x = 24$
            - $x = 12$, therefore there are 12 cows and 14 chickens.
        - This is the algebraic argument.
- <u>Here's another approach</u> (17:10):
    - Draw 26 circles to represent the animals.
    - All of the animals have two legs, so draw two legs on all the circles. When you count them, there are 52 legs.
    - If you subtract 52 legs from the total number of legs (76), you get 24 legs left.
    - If you give 12 circles two more legs to make them cows, you have 12 cows and 14 chickens.
        - Invite students to think creatively, intuitively, and outside the box.
        - Create a bit of competition for the most compelling or most beautiful and appealing argument.
        - Have students assess the quality of the argument and justify which argument is most compelling.
        - This is the *art of mathematical rhetoric*.

Challenge: Are you giving opportunities for students to engage in presenting ideas and also critiquing other students' arguments more than they already are?