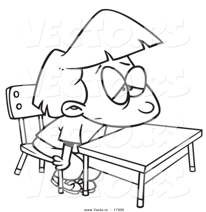
**Empowering Student Presentations**

by Susan Norton-Scott
sns@amug.org

When I was a young math student, I remember watching classmates work out homework problems on the board and thinking, “Why do I have to sit through this when I already got the right answer?” I had a better attitude while figuring out why I got a problem wrong, but as soon as I realized my mistake, I checked out mentally. My attention often wandered during math class, which I thought was both hard and boring.



Years later, as math teacher, I recognized this same mindset in several bored facial expressions and lackluster energy in my classroom. This realization motivated me to experiment using new ways to process math problems, and over time I developed a method that thoroughly engages my students. Using the 5-step system, the students themselves run the classroom and my role is relegated to being the “guide on the side.”

Instead of focusing on one correct way to solve the problem, the **goal of the entire classroom is to see how many ways we can solve a problem.** All students participate, regardless of whether they got problem right or not individually. I was astonished when students generated four, five, or six distinct ways to get to a correct solution that had never even crossed my mind. My jaw dropped when the number reached nine, and the world record was eleven. To commemorate their achievements, I took photos of the class showing with their fingers the number of solution methods displayed across the board, which by that time was saturated with numbers, diagrams, and formulas.

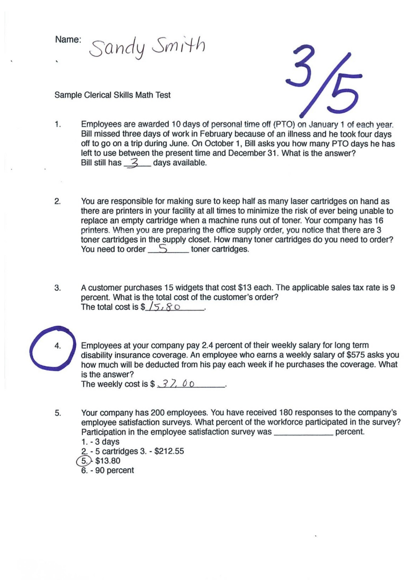
I shared this method with some elementary and middle school colleagues, many of whom now use this technique exclusively when handing back tests or reviewing homework. They reported that although it takes some time to teach this method to their students, it is definitely worthwhile because of the consistently high level of student engagement.

## SETTING THE SCENE

### Returning student work

While correcting and recording math scores, make no marks on student papers. Instead, students should receive their corrected math papers marked only with a fraction and a circle. The fraction shows the number of correct responses over the total problems, but there is no indication of ***which*** problems are correct or incorrect! (This really captures their attention!)

One problem is circled. This is the problem that they will be presenting to the class along with other students who were also assigned that particular problem. (It is important for students to have access to the scratch paper that they originally used to work out the problem so they can remember their thought process.)



Name: Sandy Smith

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Sample Clerical Skills Math Test

1. Employees are awarded 10 days of personal time off (PTO) on January 1 of each year. Bill missed three days of work in February because of an illness and he took four days off to go on a trip during June. On October 1, Bill asks you how many PTO days he has left to use between the present time and December 31. What is the answer?
Bill still has 3 days available.

2. You are responsible for making sure to keep half as many laser cartridges on hand as there are printers in your facility at all times to minimize the risk of ever being unable to replace an empty cartridge when a machine runs out of toner. Your company has 16 printers. When you are preparing the office supply order, you notice that there are 3 toner cartridges in the supply closet. How many toner cartridges do you need to order?
You need to order 5 toner cartridges.

3. A customer purchases 15 widgets that cost $13 each. The applicable sales tax rate is 9 percent. What is the total cost of the customer's order?
The total cost is $15.80.

4. Employees at your company pay 2.4 percent of their weekly salary for long term disability insurance coverage. An employee who earns a weekly salary of $575 asks you how much will be deducted from his pay each week if he purchases the coverage. What is the answer?
The weekly cost is $ 37.00.

5. Your company has 200 employees. You have received 180 responses to the company's employee satisfaction surveys. What percent of the workforce participated in the survey?
Participation in the employee satisfaction survey was ____________ percent.
1. - 3 days
2. - 5 cartridges 3. - $212.55
5. - $13.80
6. - 90 percent

**Assigning groups**
I really enjoy the "social engineering" aspect of assigning groups because I can pair a "smart student" who has an incorrect answer with struggling students, one of whom might have the correct answer. Or, I'll group a shy student with a correct answer with boisterous students with incorrect answers. Occasionally an entire group will discover that none of them had the correct response. (Sneaky, isn't it?).

"But what if the group presents the problem incorrectly?" you ask. I consider that the *best* possible situation because it offers the richest teachable moments. Keep reading.

**Preparation Time**
The problem that each student will present is already circled on their paper, so students rearrange themselves in the classroom, sitting with with others who have the same problem circled. Ideally, there are no more than 5 students per group.

Once students are in their groups, they are tasked with presenting their problem to the class so that **everyone in the group shows part of the solution.** Typically the conversation starts with "Who has the right answer?" (but nobody is sure!) and ten minutes later, they all need to be ready. I check in with groups but don't help them unless the struggle seems overwhelming. Then I give them the answer key and walk away.

## PRESENTING THE PROBLEM

**Behavioral Expectations**
- The audience must be silent during the presentation
- Presenters need to stand up straight and not lean on the board
- Speak so everyone can hear
- Look at the group member who is talking
- Write large numbers on the board, and try not to turn your back to the class for very long

**The 5 Steps for Group Presenters**
1. **"Who wants to read the problem?"**

The presentation group gains the attention of the class and then selects a classmate to read the problem aloud.

2. **Presenting the Solution**

Students take turns showing their group's solution, with everyone contributing a part of the answer. (If someone does not participate, then they are required to answer at least one question from the audience by themselves.)

3. "**Are there any questions?"**

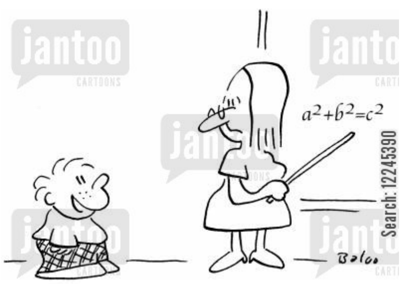
After a solution has been reached, group members open the floor and respond to classmates who have questions. Student naturally use mathematical terms to express their thoughts.

If there are no questions, I will raise my hand and ask one of my "stand-by" questions:

> *"What do you think the most common incorrect answer might be, and why?"*
> or
> *"What vocabulary did you have to know in order to solve this problem?"*

If the solution the group presented was *incorrect*, I smile to myself, sit back, and let the process unfold. After being silent while an incorrect solution is presented, the audience is usually ready to let loose and criticize. However, they **must** phrase their "objections" in the form of question (not always easy!). This requirement compels respectful, civil discourse and avoids any one student feeling like they are being "picked on." Given the opportunity, classmates want to "enlighten" the group of presenters so that they revise their solution, arriving at the correct answer *without* teacher participation. They are empowered to work out the solution. It is a joy to observe. (Of course, I will ask probing questions to get them on the right track, but only if absolutely necessary). Worst case scenario: I keep asking questions until they see their error.

4. **"Did anyone do it in a different way?"**
After all questions have been answered about the group's solution, the floor is open for additional input. If an audience member solved the problem in a different way, they get to come up to the board and explain their method. Afterwards, they ask the audience, "Does anyone have any questions?". Hint: It helps to use a different colored marker for each person's method because the board can become quite congested.



"I understand it now, Mrs. Bundy — the school janitor explained it to me!"

The question is repeated again and again until no one has a different way to solve the problem. (The teacher is welcome to contribute, too.) Looking for alternate ways to solve problems starts to become a habit, and is a useful strategy if in the future students get stuck trying to solve a problem individually. Some classes were determined to break the classroom record for the largest number of ways to solve a problem. It's also helpful to label the strategies, e.g. *make an organized chart, draw a diagram, work backwards,* etc.

Not all problems lend themselves to different solution methods, of course, but I've often been surprised at the variety of ways students think about math.

**5. "Which group wants to go next?"**
This is the transition question, to start another group presenting the another problem. Sometimes I need to remind students to mark their own papers so they will know which problems they got right or wrong.

**REFLECTION**

At the end of the class, I ask students to write "Advice to Myself" on their paper and in one sentence, summarize a tip they'e like to remember in the future. This could be:

- a reminder to continue to do something that worked ("Double check my arithmetic")
- a reminder to avoid a pitfall ("Read the question slowly and carefully")
- don't forget a critical piece of information ("1 is not a prime number")
- a self-note about presenting more effectively ("Talk louder and stand up straight")
- prompt about their attitude. ("The first answer I get is not always the correct one so don't be over confident. Try solving it another way.")

## RESOURCES

Here are four problems that lend themselves particularly well to being solved in a variety of ways. (They were the genesis of three photos in this article.) You might consider Inserting one or more of these into a problem set you already use.

1. Emma has 4 more quarters than nickels. The total value of her coins is $3.10. How many nickels does Emma have?

2. Aaron, Becky, and Chris are wearing pink, yellow, and white shirts (though not necessarily in that order). Aaron is not wearing the yellow shirt. Becky says to Chris, "I like your white shirt." What color is Becky wearing?

3. The Patriots and the Eagles played in a Super Bowl. The sum of the scores was 44. The difference of the scores was 20. The Patriots won the game. How many points did the Patriots score?

4. Peter has one of each of the following coins in his pocket: a penny, a nickel, a dime, a quarter, and a half-dollar. Four of these coins are taken out of the pocket and the sum of their values is calculated. How many different sums are possible?

These problems came from the Math Olympiads for Elementary Students program, at www.moems.org. Similar problems are available from the MOEMS website, under the *General Information* tab: "Samples" and "Problem of the Month."

## FINAL THOUGHTS

There are a couple of additional benefits to empowering students presentations. Students often explain and connect critical concepts in a different way than I would (often more effectively). Watching my students "teach" made me appreciate the diverse ways that my students' brains work, and I often felt humbled after hearing some surprisingly intense and sophisticated exchanges about mathematics.

Working effectively in groups is another critical skill that students need to practice. As future employees, students will rarely get to choose who they work with. No matter what job they have, they will need to communicate their ideas clearly and convincingly to others who may or may not agree with them. This process provides a safe opportunity to refine their communication and debate skills.

I sometimes wonder what would have happened had my own math teachers integrated social interactions with math more effectively. Certainly, my attitude would have improved and perhaps my academic performance would have been more noteworthy. Being a "guide on the side" math teacher in a student-driven classroom of energetic youngsters was not the path I thought I'd ever be on as a child, but it has certainly been a rewarding one.

http://www2.mpsaz.org/edtv/ondemand/mpsstuprod/ *Or follow the tabs:*
www.mpsaz.org —district departments—educational TV/Media—on demand—more—student productions— **5 Ways, 5 Plays** (14 min)