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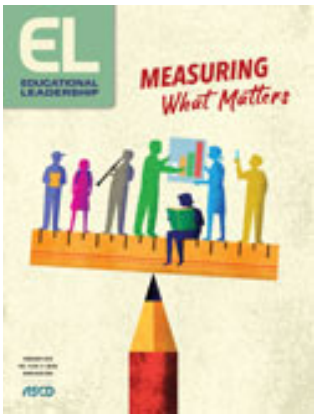

Lessons from a Protractor

Tracey Tinley

How a common math tool gave one teacher a gateway to reconceptualizing assessment.

Pre-quiz. *Survey*. *Check-in*. It didn't matter what term I used in September, the air was sucked out of math class the second there was a hint of an assessment about to take place. There was no avoiding it—my tests were becoming a problem.

Like many math teachers, I value having a starting point to gauge my students' current understanding of the concepts we'll be studying. Diagnostics—the term used in Canada for what's also called *pre-assessments*—have been my crystal ball into the future learning needs of my students. Pedagogically, they make sense. They pinpoint where the gaps might be for some learners and highlight areas where others might need extension activities.

Traditionally, at the beginning of the school year, I photocopied and handed out worksheets designed to test students' ability to count, measure, graph, and multiply. Although these tools certainly gave me usable data, I was becoming increasingly aware of something else they were generating. I saw my 5th graders shielding their answers from one another. Despite my reassurances that I didn't expect them to know all this "stuff," I saw nervous smiles and flashes of pure panic on my students' faces. Perhaps most disturbing of all was the absolute silence in our classroom during these assessments. Were these the messages that I wanted my diagnostics to send? Was this performance anxiety what I wanted my students to think the initial phase of learning was all about? Something had to change.

Breaking My Own Tradition

Tradition is a powerful force in our teaching. A study of place value has always been my lead-off unit at

the start of the school year, no matter what grade level I'm teaching. However, this past year, I questioned that plan. I'd spent the first few days of the school year planting the seeds to build a math community, and I wasn't sure that place value would be the best soil to grow the level of discussion I was trying to cultivate.

Also, despite the grade level written on my classroom door, I had students who were working multiple grade levels below their peers in number sense. It seemed counterintuitive to begin with a concept that might make some students feel at a disadvantage. So I began with a math area likely to spark questioning—and provide an entryway for everyone. We traded our base ten rods for triangles, quadrilaterals, and polygons. We swapped our calculators for protractors. Geometry became the new language for the start of our math class.

I decided to start with something hands-on that invited students to unpack ideas themselves, rather than by introducing concepts or formulas. I introduced them to the protractor. There are no shortcuts or algorithms for teaching children how to use a protractor. It's a little half circle that takes no prisoners. It also happened to be the catalyst in the evolution of my use of pre-assessments.

"What Do You Notice?"

I began our first math lesson of the year with a photocopy of three different styles of protractor and two prompts: What do you notice? What do you think it might mean? Students worked in pairs throughout the 40-minute period to record their observations about this new tool—the lines they saw, those mysterious double rows of numbers and that big 90 right in the middle. And while the students recorded their observations, I did a little noticing of my own. With the students organized into talking pairs, their thinking was visible. I listened. I wrote. I listened some more. (For one thing, I was curious whether students would connect what they'd learned in 4th grade about the benchmark right angle to this new tool.) But I wasn't scoring their answers with levels, or quantifying their observations with points. Instead, I used their conversation to help me guide and shape the next day's discussion.

This process allowed me to diagnose students' math understanding in a way that was far more powerful than any written assessment I could've prepared. Would a traditional diagnostic have identified the seven students who didn't even notice the double rows of numbers on a protractor? Would it have allowed me to see the one student who figured out that two protractors put together make a circle, and that a circle must equal 360 degrees? I probably would have seen a lot of errors or partial responses, but the conceptual implications of those responses would've been lost to me. What's more, the students might have been left feeling confused, discouraged, and disheartened by a more traditional diagnostic that simply asked them to record measurements using a tool they might not understand.

Conceptual Conversations

Each day, my students' confidence grew as they demystified the protractor a little more. We used observations I recorded during math class and our follow-up group discussions as assessments *for* learning. In each class, I diagnosed an area or two that some of the students seemed to be stalling at.

The next day, we'd engage in problems or activities designed to have us bump into these misconceptions or difficulties.

For example, during one class, I noticed that several students were continuing to find it difficult to determine which measurement to use on the protractor. When measuring a 60-degree angle, for instance, they were uncertain which of the rows of numbers on the protractor to look at. A 60-degree angle would also have the measurement of 120 degrees listed above it, and many students simply guessed whether it would be 60 or 120 degrees. They forgot to apply what they knew about angles, such as that a 60-degree angle couldn't be 120 degrees because it was smaller than a right angle. When I asked them about their measurements, they could offer little rationale as to why it was one number instead of another, even when their measurement was correct.

This scenario became the prompt for a problem the following day: *"Mr. Tinley says the angle measures 120 degrees, but Mrs. Tinley thinks it might be 60 degrees. Who is correct? How do you know?"* The quality of discussion that came out of this activity was inspiring. Comments like "I know it can't be 120 degrees because it isn't even as big as a right angle" showed me that some students were connecting to a previous understanding of the benchmark right angle of 90 degrees. Students began to make their thinking transparent.

Allowing students the opportunity to articulate and share their conceptual understanding with one another is powerful for all involved. There's no need to find the correct "kid language" to explain the concept, as the kids do the majority of the explaining. I listened as students gave one another advice that ended with "Don't worry—this confused me too at first." I watched as my students increasingly began to seek out one another with their questions and concerns when they became stuck. Math class suddenly became an exciting place of possibility. Math became something you could learn to be good at even if you'd found it challenging in the past. And I watched as students learned that they didn't need others to "lose" in order for them to "win" in class. We could coach and support one another toward understanding without worrying about how this might affect our own grades. Slowly, learning became less of a competitive sport.

Learning How to Learn

We've continued our learning journey since those protractor lessons. These two prompts "What do you notice?" and "What do you think it might mean?" became common phrasing in a lot of my later pre-assessments. I often use these prompts when I give students their first exposure to a math concept. They let students offer their insights and thinking in a low-stakes environment while providing me with more detailed feedback into the how and why of their thinking. For instance, 5th grade students have had little experience with broken line graphs. Showing them samples right up front and allowing them to make connections to what they already know allows me to pinpoint areas that will be problematic for students as well as aspects they can easily connect to previous learning.

I've watched my students develop trust in themselves and one another as learners. They've become more comfortable when I ask them to tell me what they think they know about a topic before we begin. They've learned to trust that the information they give me will be used *with* them, not against them, and that I'll use pre-assessments to guide them toward their best math selves.

Together, we are learning how to learn.

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