What does it mean to do math or science?

As a student raised in a Caribbean household, I found that there were times when my home culture and my school culture begged different responses to the same stimuli. One such stimulus was the question: “What are you doing?” quickly followed by “What are you thinking?”

“WHAT ARE YOU DOING?”: THE HOME EDITION

As a child, this phrase caused me angst. When I heard those words, I knew I’d done the wrong thing or my actions were misunderstood. I didn’t interpret this question as one where the asker was genuinely curious. I heard judgment. Usually, “What are you doing?” was followed by “What were you thinking?” In either case, I was reluctant to provide any response because I believed anything I said would be inadequate to resolve the issue. Even in my reluctance, I’d respond with a version of “I don’t know.” or “I am doing what I thought you asked me to do.” I’d learned that if someone had to ask what I was doing, I must be doing it wrong. Because if they were looking at what I was doing, and I was doing it right, they’d understand it. They wouldn’t have to ask me about it.

The challenge with my learned response to these questions is they were not only asked at home. They were also a part of my learning experience in school as a student, and it was hard not to bring my home baggage with me when I was asked that question by a teacher or peer, especially in STEM classes where solutions and processes were easily comparable.

“WHAT ARE YOU DOING?”: THE SCHOOL EDITION

What do you think happened when I became a high school math teacher? I’ll tell you. Early in my career, I found all manner of ways to ask students what *they* were doing. My finger would linger too long on a solution step when I monitored student progress. I’d offer a well-placed “huh” when watching a student work on a task. I’d even ask questions like “Are you sure you are done? Have you looked over everything? Do you want to revisit the last few problems before your final submission?” I don’t remember asking students what they did because usually, I could tell by what they were writing. I only asked them questions if they were wrong *or* if I knew they were right. When it came time to share class ideas, I stuck with partially correct and correct ideas. I was doing all that pre-work to ensure that every student was right or partially right, which robbed my students of the opportunity to engage in sensemaking, reasoning, and critique in my class.

In hindsight, my best efforts did not support the development of independent thinkers. I was, at that time, reinforcing the idea that to be a math doer you had to be right.

"WHAT ARE YOU DOING?": THE KNOWLES EDITION

Now that I am a professional development provider for early-career mathematics and science teachers, my relationship with the question "What are you doing?" has shifted. At Knowles, we invite our Fellows to investigate doing. The question that drives our work in the first year of the Fellowship is, "What does it mean to be a doer of mathematics or science in my classroom?" To generate knowledge about this, Fellows engage in a few different experiences:

1. Fellows reflect on their experiences with doing and surface the potential origins of their conception of doing.

2. They participate in collaborative inquiry to develop a shared understanding of doing across districts, classroom contexts, and curricula.

3. They critically engage with the Math Practices and the Science and Engineering Practices to see how outside perspectives add to the knowledge they are generating from working with their students and with each other.

From this work, Fellows have shared the following reflections with us.

I know my students are doers of math or science because…

> They exist. By existing they are doers of math and science. In each decision that they make daily.
> They are failing.
> They're discussing, arguing, critiquing, and making sense of their ideas and the ideas of others.
> They are interacting with one another and tackling the process of understanding the problem presented to them.
> They are showing me they understand the "why" and not just the "what" of what they are doing.

One Fellow shared a kernel of knowledge they generated through engaging in collaborative inquiry. They said, “In particular, I learned a lot from my Knowles peers about the importance of revising as a way of attending to precision and being vulnerable when developing problem-solving perseverance.”

These reflections show us that an expansive view of doing can push teachers and students beyond viewing math and science learning as a place where one needs to be first, quickest, and correct. It also suggests that the more teachers engage their curiosity about what students are doing and how they engage with math and science, the more they can figure out what is relevant to their students.

And for each positive reflection about the process of uncovering what it means to do, there is a reflection that begs the question, “What do I do now?” One Fellow shared:

I think working through the disciplinary practices [i.e., math practices/science and engineering practices] gave me a greater understanding of things that I would like to see my students do, but I think I am still struggling to engage the students I am struggling to support. The students I am struggling to support don’t engage in student actions and the teacher actions I am trying are not being successful. I did feel more confident about actions I should be looking for in students and similarly, actions I can continue to use or try to help push them forward.

Even as teachers’ ideas about doing math or science expand, there are still moments when those ideas may not align with what students do in class. There are moments when the doing is missed because it’s a challenge to watch one student, in a class of 35, just so you can catch them doing.

So what are some next steps that can support all of us educators in our next interactions with learners?

1. Remember, the learners you interact with are likely nervous about being caught making a mistake, so normalize curiosity. Ask about reasoning regardless of whether an answer is right or wrong.

2. Spend some time reflecting on what you think doing is. If you find that only

certain students come to mind when you think about doing math or science, spend some time paying attention to students who didn’t come to mind.

3. Ask students to help you point out doing. They notice who is asking good questions, sharing their processes, and inviting other perspectives in the classroom. Begin to praise those moves, and the culture of your math or science class can shift.