Q&A: Joshua Zucker

The Art of Problem Solving—and of Question Asking

IN THIS ISSUE OF THE JOURNAL, reporter Kathryn Baron writes about high-ability math students and some of the private organizations that provide them with challenges beyond what they encounter in school. *Education Next* editor Martin West spoke with Joshua Zucker, a veteran instructor with Art of Problem Solving, or AoPS, a for-profit company that offers online courses for young math lovers.

Martin West: How does the math instruction offered by Art of Problem Solving compare to what's typically available in public schools? Do you simply enable students to move more quickly through a sequence of advanced courses, or is it a fundamentally different approach?

Joshua Zucker: I think it's both. A lot of students are bored in math class. They want more, they want it faster, and they want to be pushed to think harder and discover more. So, we do give an opportunity for acceleration, but even more important, our values are different. We place a lot of value on strategic thinking, problem-solving strategies, and mathematical communication. We work on giving young kids problems that require them to express themselves and communicate about their thinking process and how they solve the problem, and we give feedback about both the mathematical content and the communication skills. Communication is often neglected in math classrooms. It's left to the English teachers. But clear, logical communication can also be taught through mathematics, where we have well-defined signposts on what marks rigorous thinking, and we can evaluate whether students are communicating at that level.

MW: You teach courses online, but the interface you use is decidedly low tech, with no audio or video, just a screen that enables you to post problems and offer instructions and hints. What are the advantages of that low-tech approach?

JZ: In some online classes the goal is to try to replicate what it's like to have everybody in the same room together. Instead, we ask: how can we take advantage of the fact that we're *not* all in the same room? Teaching without audio and video means kids can be a little bit behind or they can be rushing ahead to go further. With the text interface, they can scroll back up and study a point they really need to think about, or they can ask a question and get individual help. And I can ask how students got an answer.

In a math classroom, there's a tendency for the same kids to raise their hands right away, which can discourage others from trying to figure out the problem themselves. Online, we can have 20 of the 50 kids "shouting out" an answer to the problem, metaphorically speaking, but the other kids don't know it, because only the instructors see their comments.

MW: In her article, Baron reported that in 2015, the United States won the International Mathematical Olympiad for the first time in 21 years and won again in 2016 and 2018. All 16 students on those three teams had enrolled in AoPS courses—more than a hundred courses in total. What role do national and international competitions play in the education of high-ability math students?

JZ: AoPS came into being in part to help serve the kids who have an interest in competitions. Thirty years ago, those kids had to sit alone in their rooms and prepare by themselves. Now we have hundreds of them taking courses every year and training together with really hard problems. Sometimes I wonder if I'm really helping that much, because the kids provide so many of the great ideas. The service we provide is enabling the kids to interact with each other, bringing them into one "place" where they can share the experience of struggling with these problems. That becomes their community of support.

MW: You've had experience as a high-school math teacher. What is an important lesson schools can learn from the success of AoPS and other such organizations?

JZ: Mathematics is fundamentally a human activity, and it's about creativity just as much as writing a good essay is. There are rules and structure, but there's also exploration and individuality; people's work is not going to look exactly the same. There's a tendency in mathematics to focus on following procedures and getting answers, but to me, that's the part of mathematics that computers are better at than humans. So let's focus on the parts humans are good at—the creativity, the communication.

Along with that comes a different way of asking questions—genuine questions. In a classroom or textbook, the questions are often just prompts for following the steps and getting the answer. I want to ask questions like, "How did you approach that? What did you try here?" That kind of query is much more inviting; it says, "I want to know about your thinking." I'd like to see a lot more questions like these in classrooms throughout the country.

This is an edited excerpt from an Education Next *podcast, which can be heard on educationnext.org.*