The Mystery of Mathematics

**Teaching and learning math as a human endeavor**

*by Jacob Barandes*

A couple of years ago, I found myself reading through the “Principal’s Column” in an email newsletter from my kids’ elementary school. In her essay, the school principal wrote, “I don’t have memories of curling up with a workbook and solving equations the way I have memories of reading a good book in front of a fire. Math feels like work, while reading feels like pleasure.” I found it disheartening to see mathematics described in this way by the head of a school, as though recreational or professional mathematicians spend their time trudging through workbooks.

Unfortunately, I can attest that this perception of mathematics is widespread in education circles. And this mentality has real impacts on children. When I talk with high-school students, I often hear from those who enjoy their math classes that their favorite things about math are its rules and its definite answers—and I usually hear the same from students who don’t enjoy their math classes.

How has it come to this?

In some ways, math is a victim of its own success. Math has given human societies so many powerful tools for invention, for science, and for our practical needs that it’s hardly surprising that methods and applications of mathematics have come to dominate how it’s taught today.

But math can’t be reduced to these methods and applications, any more than the visual arts or journalism or music can be reduced to their methods and applications. Real math isn’t about memorizing arcane terminology, or following a set of rules and procedures laid out centuries ago, and has as much to do with workbooks and long division as real writing has to do with diagramming sentences or memorizing vocabulary.

Real math is a quest driven by curiosity and wonder. It requires creativity, aesthetic sensibilities, a penchant for mystery, and courage in the face of the unknown. It involves playing around with ideas, shapes, concepts, numbers, and structures; asking questions; collaborating with others; looking for patterns; breaking out of old paradigms; recognizing beauty; connecting with a transcendent realm of immortal entities; and making convincing cases to defend your claims. Real math is about making bold conjectures and then figuring out how to turn them into eternal theorems by proving them, or finding connections between existing mathematical tools and the worldly phenomena that surround us. Kids can start to do real math as soon as they’re able.

**Mathematics for Human Flourishing by Francis Su, Ph.D. ’95 (Yale, s26).**
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Francis Su

MARK SKOVORODKO FOR QUANTA MAGAZINE
man. Su also lays out the case that doing math doesn't just make a person a better calculator, but builds character in a whole assortment of different ways. The book is organized around a set of human virtues—"imagination," "persistence," "hopefulness," "confidence in struggle," "disposition toward beauty," "inventiveness," "joyfulness," and "love"—the last of which Su gives its own complete chapter.

He has a lot to say about the way schools teach math (or fail to do so). His views are well summarized early on:

When some people ask, "When am I ever going to use this?" what they are really asking is "When am I ever going to value this?" They're equating math's value with utility because they haven't seen that they can value anything more than its usefulness. A grander, more purposeful vision of mathematics would tap into the desires that can entice us to do mathematics as well as the virtues that mathematics can build.

Su contends that we're all math educators in one form or another, and that we should avoid presenting mathematics to the impressionable young minds around us as a strict set of procedures to be committed to memory, or as an innate capacity reserved for a select few:

As a mathematical learner, don't let yourself be sucked into an education that champions mathematics as pure logic, cold and heartless, a bunch of rules to follow. Who would want to learn that, or teach that? That is not where the heart of mathematics is. You cannot separate the proper practice of mathematics from what it means to be human.

He writes that we should instead communicate that math is an exploratory adventure, and anyone can become proficient at it.

I can speak from personal experience that cultivating skill at mathematics can bring a great deal of joy and satisfaction, much like learning the art of gourmet cooking or playing a musical instrument.

The book is filled with thought-provoking and inspiring statements, such as a quotation from the math educator Fawn Nguyen, whose words teachers in every discipline should take to heart: "Critique the effectiveness of your lesson, not by what answers students give, but by what questions they ask." Emphasizing the value of
The “freedoms of mathematics” include the freedom to solve problems, to explore new directions, to open one’s imagination, and to land in a welcoming community.

mistakes and the importance of struggle to the process of personal development, Su writes that “even wrong ideas soften the soil in which good ideas can grow.” In pushing for a more welcoming attitude in mathematical communities, he also sagely points out that “Background is not the same as ability.” And he takes a refreshing point of view on freedom:

I know that some people define freedom as “the absence of constraints,” as if it means “do whatever you want.” I don’t believe that’s what true freedom is. True freedom never comes without cost, relationship, or responsibility... Those of us who have experienced the freedoms of mathematics have a significant responsibility to welcome others to those freedoms as well.

Among the freedoms he describes are the freedom that comes from knowing many approaches to solving problems, the freedom to explore new directions, the freedom opened up by one’s imagination, and the freedom found in a welcoming space or community. He points out that teachers are in a special position to foster all these freedoms—and that they have a distinct obligation to do so.

Along the way, Su takes many opportunities to show readers what he means by the enchantment of math, by filling his pages with intriguing and inspiring math puzzles. These include cutting up a pan of brownies, comparing rectangles, devising ingenious variations on Sudoku, counting the ants crawling around on a wooden log, and figuring out whether a planet’s surface can always be divided into hemispheres that put four out of five points in the same hemisphere.

Mathematics for Human Flourishing is by no means a traditional math book. There are very few equations in it, and Su weaves in many personal details from his own life: his adoption, his parents’ illnesses, his personal experiences with racial identity, his challenges in graduate school, his efforts to make math a more inclusive discipline for newcomers, and his long-running correspondence with a federal inmate learning advanced math. True to the spirit of his book, his exposition is deeply human-centered, and begins with an apt quotation from the philosopher Simone Weil that animates the book as a whole: “Every being cries out silently to be read differently.”

Who is Su’s book for? Like mathematics itself, Su’s book is for everyone. It’s for students in high school or college who are new to the subject and may sometimes feel discouraged or uninspired. It’s for people who may have had challenging experiences with math in school but are open to re-evaluating their feelings. It’s for professional mathematicians who are thinking about how they mentor students and reach out to their larger communities. It’s for parents who recognize that their attitudes toward math have profound effects on their children. And, above all, it’s for teachers of every kind who ought to think carefully about what they’re teaching—and why.

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