Letter to the Editor

I was thinking about a recent article in Notices and membership. I felt compelled to write a few thoughts down.

I am not a mathematician, or a professor, or in academia; I am an engineer with a bachelor’s degree. It was years ago that I decided to put the compulsive side of me to good use. I love to delve into things that seem trivial to most. Spending hours in libraries when I was younger. Now, in my home office, entertaining fanciful cerebration of complexities and simplicities. Most of which are in vain, however I persist.

It is the quiet gems in life that fascinate me. The ideal of things hidden to all but the initiated. The thoughts, the dreams, and the discovery of the schemes. It draws me to the American Mathematical Society. It takes me years, and sometimes never, to fully appreciate the complexities presented in just one article. The perspective of applying a discipline in new and imaginative ways that our future calls upon us to invest in. To venture out of the prescribed ways, I get a glimpse of wondrous thoughts.

The authors—the brave, the talented, the steadfast; how their work speaks to the definition of character. I am in awe of them. These people who think in silence, who work tirelessly to reveal hidden meaning to us. The surprises. Yes, every issue has them in so many ways. The latest—“Dendrimer Population Cycles in Infectious Salmon Anemia Models.” A fascinating tale. Broken down to concepts and yet leaves the reader to discover the numerous complexities of it all. It draws the curious to a place where we want to know more.

I thank you for providing a place where I am welcomed to gaze upon your world. A place where imagination is fostered. The humble and imaginative. The love of your chosen path outlined on pages. For what you believe in, requires you to invest. It is up to us, those willing to travel along with you, to care more and do more. I thank you for allowing me to be part of this noble endeavor. I will support AMS in whatever ways that I can.

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*We invite readers to submit letters to the editor at notices-letters@ams.org.*

To the Editor

Jana Gevertz and Joanna Wares illuminate the challenges that top mathematics departments face in diversifying their graduate student populations. However, increasing the number of applicants from historically under-represented groups cannot, by itself, fully meet these challenges. We must also expand the cohort of students who are prepared, both personally and academically, for graduate study, and increase the number of institutions that are able to meet the needs of a more diverse student body.

Postbaccalaureate programs can provide the necessary academic preparation and personal mentorship. We represent the Postbaccalaureate Certificate in Mathematics program at Iowa State University and the Causeway Program at Northwestern University. By focusing on coursework, mentorship opportunities, and career orientation, our programs strengthen the foundations for graduate study and help students build confidence.

To make an impact, more institutions must join in these efforts by creating their own programs or by contributing to the sustainability of an existing program. In October the American Institute of Mathematics will host a conference on best practices for postbaccalaureate programs (see aimath.org/workshops/). Institutions can help sustain an existing program by joining the Causeway Consortium.

There is no silver bullet here. Lack of diversity in our graduate programs is persistent, severe, and a blight on our profession. Meeting this challenge requires a multifaceted approach that includes increasing numbers and improving preparedness—among both applicants and institutions.

Signed,

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Letters to the Editor

The Elephant in the Room

We write in regard to “Reflections of a Mathematics Teacher Educator: Considerations for Mathematicians Who Teach Teachers,” February 2020 Notices. We, like Dr. Eubanks-Turner, share a profound concern for the education of teachers, and we believe “[t]eachers need to see clear connections between the mathematics that they are learning and the mathematics that they will teach.” In fact, we agree with most of what she says; it is what is not said that raises our alarm. If we are to make serious progress in improving K12 mathematics education, we must acknowledge The Elephant in the Room: nearly every prospective teacher learned a defective version of mathematics in primary and secondary school, and unless some action is taken to provide a correct version, the defects will be passed on to multiple generations of students and the cycle of non-learning will continue.

One might think that a university mathematics education would be sufficient to give teachers the tools they need to repair their knowledge, but this is not the case. Prospective teachers need more than “clear connections”—they need to learn, for the first time, a coherent version of the mathematics that they will teach. Even a graduate degree in mathematics isn’t automatically sufficient—I (JFA) have been surprised at how many university faculty have claimed that students must learn fraction multiplication before fraction addition because multiplication is needed for the following “justification” of equivalent fractions:

\[
\frac{a}{b} = \frac{a}{b} \times 1 = \frac{a}{b} \times \frac{c}{c} = \frac{ac}{bc}.
\]

The logic here is circular; \(1 = \frac{c}{c}\) is assuming what is to be proved. In any case, the concept of equivalent fractions is so fundamental that it really needs to be learned almost immediately after fractions are defined.

Another example may be taken from JFA’s daughter’s fourth grade math text. Therein, students are encouraged to reduce \(\frac{12}{16}\) as follows:

\[
\frac{12}{16} = \frac{12}{16} + \frac{0}{0} = \frac{0}{0}.
\]

This is problematic for several reasons. First, division isn’t introduced until several chapters later. Presumably they are supposed to write

\[
\frac{12}{16} = \frac{12}{16} \div \frac{4}{4} = \frac{3}{4}.
\]

The other problem is that, when they do learn fraction division, they will learn the invert-and-multiply rule, hence will be taught to write this:

\[
\frac{12}{16} \div \frac{4}{4} = \frac{12}{16} \times \frac{4}{4} = \frac{48}{64},
\]

which is totally unhelpful for reducing fractions. This is not mathematics. This is incoherent nonsense. And one of the authors of the text is a renowned mathematician.

A final example is taken from my (BLP’s) experience as a high school teacher. One year, my department identified a lack of “understanding” of percent among our students. We attempted to improve their understanding by “explaining” percent through examples and exploratory activities. At the end of the day, what students gained was the ability to recognize when they needed to move the decimal point one way or another, but not the understanding of the relationship between moving a decimal point and multiplying by a power of ten. I see now that, had we given a clear definition of “\(N\) percent” as \(\frac{N}{100}\), we would have given students a real tool to move forward with. As passionate teachers, we were willing to go the distance to help students, but were not equipped with the tools to do so effectively. We should be encouraging students to ask “why?” but we must be ready with mathematically correct answers. I had never been taught anything more than “move the decimal point” nor had I ever thought to question why we did it. Ever since learning a coherent version of school mathematics, including a definition of percent, my eyes have been opened to the tragic ineffectiveness of education without such definitions.

We can do better than this. It is up to us in the professional mathematics community to contribute. Dr. Eubanks-Turner mentions the issue of access: “Further, this helps dispel beliefs that mathematics is accessible only to certain people who are ‘smart enough to get it.’” Yes, we should change the culture, but a necessary step towards doing so is to change the curriculum. All evidence points to the great difficulty most students face in making sense of the disjointed, haphazard assortment of facts presented to them; it is understandable that many give up in the face of such a task. Common Core is an important step in the right direction, but teachers and parents misunderstand it, so there is much work left to be done.

One of the most crucial steps is to give precise, usable definitions of concepts, like “fraction.” Working with a well-formulated definition empowers the user in surprising ways, as has been borne out in professional mathematics since the mid-20th century. In reply to those who would argue that reasoning based on precise definitions is not appropriate for K12, we respond thus.

1. We as a discipline learned the hard way that reasoning from intuitive (but imprecise) formulations does not lead reliably to correct conclusions.

2. We cannot dismiss (1) in the K12 context just because we happen to know that we “got the correct answer this time.”

3. It is extraordinarily unjust to deny students access to the methodology that allows us to be confident in our conclusions. By so denying, we force them into rote learning.
Letters to the Editor

So by all means, do the things Dr. Eubanks-Turner recommends. But we must also teach future teachers a corrected version of the mathematics that they will have to teach. It is not fair to expect them to figure it out themselves.

We must acknowledge The Elephant in the Room.

Respectfully,

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