

A WORD FROM...

Francis Su, Vice-President of the AMS¹



Photo courtesy of Francis Su.

Imagine a ship that, every year, picks up a handful of recruits, each one eager for an adventure: to see the world, to learn how to navigate by the stars and steer through turbulent seas. These recruits all look forward to running their own tours of this kind one day. They each grasp that they are in for a long journey of intense training.

If you knew that, of the 3600 apprentices recruited every year for such adventures, only 1900 complete the journey, wouldn't you think something was terribly wrong?

If you inquire of leadership, you'll hear excuses like these, blaming those who left:

"He must not have been able to handle it."

"We really don't know what happened to her... she just sort of disappeared."

"I expected the people who sign up for this to have all the skills they need already."

"We're here to explore the seas. It's not my job to worry about crew morale."

Is your math PhD program like this ship?²

According to the AMS Annual Survey, approximately 3600 students enter math PhD programs in the United States each year, but only about 1900 finish.³ Is it acceptable that nearly half of all students who enter PhD math programs never complete the degree? Do we blame the ones who left? If we believe everyone we admit is capable of completing a PhD, why don't we do more to ensure that they succeed?

To be sure, a few students every year leave for better opportunities, but a significant number leave because of disillusionment with our programs or of active neglect. And yes, math is not an outlier compared to other kinds of PhD programs, but this only reveals what strangeness passes for normal in academia.⁴

I believe many of you reading this article care deeply about your program and your students, especially graduate directors, who often work tirelessly to improve the graduate experience. But I also understand that 2020 has brought us all more pressing emergencies to deal with. So let me cast this moment as an opportunity.

The COVID-19 pandemic and the resulting social upheaval have disrupted our usual way of doing almost everything in our lives, including our work. Pivoting to online teaching in March put us in the uncomfortable state of learning new ways of operating. The national uproar over racial injustice in June may have sparked uncomfortable conversations about racism—less familiar territory if you are not a person of color. The rapidly declining outlook for the financial health of colleges and universities has threatened the security of our profession. The coronavirus itself has caused us anxiety about our own safety and hampered our ability to function professionally, raising our own awareness of the differential impact of the virus due to childcare, health, race, and age.

Francis Su is a Vice-President of the AMS and the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College. His email address is su@math.hmc.edu.

¹The opinions expressed here are not necessarily those of the Notices or the AMS.

²Although I only address PhD programs in this essay, you might also consider your undergraduate math program. Why is it that at the undergraduate level, across all races and ethnicities, college students intend to major in STEM at the same rates, but rates of STEM-completion for underrepresented groups are little more than half those from other groups? (25% vs 45%; see Eagan et al., *Examining STEM Pathways among Students Who Begin College at Four-Year Institutions*, National Academies Press, 2014).

³The AMS Annual Survey (www.ams.org/annual-survey) in 2013 counted 3,623 first-year graduate students in doctoral math departments, and comparable numbers in prior years (see www.ams.org/profession/data/annual-survey/2013Survey-DepartmentalProfile-Report.pdf). The Annual Survey in 2017 counts 1,957 recipients of the PhD in 2017 and comparable numbers in prior years (see Golbeck, Barr, Rose, "Report on the 2016–2017 New Doctorate Recipients," AMS Notices, August 2019; also at www.ams.org/profession/data/annual-survey/2017Survey-NewDoctorates-Report.pdf).

⁴See "Why Do So Many Graduate Students Quit?" *The Atlantic*, July 6, 2016, <https://www.theatlantic.com/education/archive/2016/07/why-do-so-many-graduate-students-quit/490094/>.

We're all on a new ship—one with new operating rules—in a stormy sea. We're all now in learning mode, having to contend for many months with rapidly changing conditions, feeling like novices at our profession again. Many of us have forgotten how jarring it can be when half the things you need to learn on a moment's notice aren't mathematical. We've also forgotten how it feels when the future seems so unstable. Maybe now we can begin to empathize with what many of our students deal with on a daily basis, with or without a pandemic.

Perhaps the pandemic can teach us how important community can be to help us function as mathematicians. Perhaps it can remind us that the privileges which some enjoy are not enjoyed by all. Maybe what we have lost in a Zoom classroom we can reclaim by the way we demonstrate care and concern for our students as human beings.

How? Working to improve your program will require some hard work and deep thinking about your context, but I'll offer a few bits of advice.

1. Assume that every graduate student you admit is capable of completing the PhD. (You wouldn't have admitted them if you didn't believe that, right?) Your program design should reflect that message in a way that every graduate student can *feel*. Ask your graduate students if they hear this message.
2. Work to identify the causes of attrition, in a way that does not assign blame to students (e.g., "they were poorly prepared"). Conduct exit interviews with students who leave your program, and give your faculty an opportunity to discuss the findings. The point of this exercise should be to improve your program, not narrow your admissions criteria.⁵
3. Establish a common understanding among your faculty that it is not just the responsibility of the graduate director to create a welcoming environment for new students.
4. Build support structures for students, especially for groups traditionally underrepresented in your department. The support structures should not place the burden only on a few faculty. Also, such structures should be robust, with many safety nets in case one structure fails. For instance, provide each graduate student multiple avenues for receiving mentorship. Study successful programs, such as those recognized by the AMS' award *Programs That Make a Difference*.
5. All faculty need space to reflect on their teaching practices, and most desire to improve. Provide incentives to professors to grow in their teaching and mentorship. There is much evidence-based research now about how students learn best, and many resources exist to learn how privilege, implicit bias, and racism can affect teaching and learning as well as the health of our profession. See this endnote for places to start.⁶
6. Deepen your criteria for hiring faculty. Consider candidates with excellent research programs who additionally demonstrate a commitment to mathematics as a public good that everyone deserves to share in. These are the ones who will care for new recruits, ones whom we can count on in a storm to leave no one behind. These are the ones who make the best colleagues, who will be there when all hands are needed on deck.

Now is the time, while all aspects of education are being reconsidered and remodeled, to build seaworthy structures for the ship that is our profession. Losing nearly half of our recruits should no longer be tolerable. Perhaps it's been this way because as mathematicians, we are often lulled into believing that our only priority should be research. May the upheaval of 2020 remind us that exploring the mathematical seas requires investing in the nurture and well-being of our crew.

Who will we abandon in the stormy seas? For the sake of our profession, let us all endeavor to say: no one.

⁵You'll likely find narrowing your admissions criteria won't solve your attrition problem, and doing so would contradict the assumption in Point #1: that beyond some competence threshold, every graduate student you admit is capable of completing the PhD.

⁶The AMS-MAA publication *Living Proof: Stories of Resilience Along the Mathematical Journey* (A. Henrich, E. Lawrence, M. Pons, D. Taylor, eds., 2019) contains accounts by mathematicians of struggles they've overcome to pursue a career in mathematics. A free PDF version can be found at <https://www.maa.org/press/ebooks/living-proof-stories-of-resilience-along-the-mathematical-journey-2>. To learn about evidence-based best practices in teaching, consult the MAA *Instructional Practices Guide (2015)*, available at <https://www.maa.org/programs-and-communities/curriculum%20resources/instructional-practices-guide>. Several of the AMS blogs at <https://blogs.ams.org> have useful articles for learning and reflection, most notably these blogs: *inclusion/exclusion*, *PhD+epsilon*, and *On Teaching and Learning Mathematics*. See also Ben Braun's recent post: <https://www.mathvalues.org/masterblog/10-ways-to-build-inclusivity-at-phd-granting-institutions>.