

## **The Future of Graduate Student Programs – summary of discussion held at the CBMS Council Meeting on December 4, 2020**

*Supporting recent PhDs through the difficult academic job market of the next few years. Should we be shrinking PhD programs? letting our students stay for  $n > 7$  years? Running more math to industry programs to help them get jobs there? What are the societies' roles in shaping this discussion?*

These are summaries of the comments made by the participants in this discussion:<sup>1</sup> Edray Goins (CBMS EC), Ruth Haas (AWM), Dave Kung (TPSE), Michael Pearson (MAA), Catherine Roberts (AMS), Mark Green (National Academies & TPSE), Mike Ferrara (NSF), Jessica UTTS (IMS), Kathryn Leverenz (Math Institute of Wisconsin).

Catherine: The Simons Foundation is paying for several postdocs at the NSF Math Institutes.

Mark: We should think about the question: What does the world need PhD mathematicians for? Math PhD's are needed in many different realms, and the answers can inform how we train students. We should provide more opportunities for those students who want it to learn more about working in industry, government, national labs, etc. Only a comparatively small fraction of undergraduate math majors go on to grad school in math, and only around half of math PhD's go into academic jobs. (Dave: But half of those drop out without a PhD!) Change in graduate programs is probably going to come from the institutions which have the ability and desire to experiment.

Michael: How much has our perception in the academic community changed? How do we view what it means to be a mathematician? How do we come to a new place where there is a bigger tent in being in the mathematics community? This has to be led by the folks who produce the bulk of graduate students. Many, even at undergrad institutions, don't see it as part of their job to support undergrad majors to get industry jobs.

Catherine: Our existing ideology of hierarchy and "elite" supports systemic racism.

Mike: I was at a TPSE conference where there was discussion about undergraduates majoring in math. There was a feeling among some faculty that it's not their job to help their students to get jobs.

Ruth: I'm a grad chair, and I was talking with a grad student about getting jobs. This student was fearful that he had failed because I recommended that he consider a job at a liberal arts college.

Dave: We can work to change the language we use to describe elite institutions. There was a survey at Ohio State asking whether the grad students were interested in industry jobs. Something like 90% of the grad students said they were interested. The [Erdős Institute](#) at Ohio State is getting some information out there about

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<sup>1</sup> Their names are associated with their comments with their permission.

Edray: Illinois has an internship program (summer experiences in industry). Are there other places? (Dave: Erdős Institute at Ohio State does this.)

Mike: At my prior institution, we had a small program where people could do an internship for credit. Increasingly, it also seems that jobs at PUIs, liberal arts schools, "smaller" institutions are what I would have called unicorns in my earlier years. Maybe 3,4,5 papers, uncommon teaching experiences, a postdoc, etc. That makes the academic path more challenging to walk as well. I see dozens of really talented early PhDs that would have had a ton of offers when I was on the market stuck in a seemingly never-ending chain of 1-year visiting gigs.

I found that students who could land summer internships at the labs was a way to mitigate pushback. It was seen as "academic enough" since papers might come out of it.

Jessica: How much pushback is there to not do internships? One student had a Facebook internship and got some flack for not spending that time on research - but it's served her well.

Catherine: The culture of "elitism" is so embedded in our culture - it might be better to inoculate our students against such things, since this might be easier than successfully changing the culture.

Ruth: How do we push back against this culture? We're so steeped in Real Analysis and Algebra. Some students know exactly what they want - but many others are much more influenced by the culture.

Edray: How do we get more Black students as math majors? Many students of color are looking for financial security - and see CS as having a more financial security.

Catherine: <http://www.ams.org/profession/career-info/career-index>

Dave: There's a good point, not everyone has the financial privilege of doing mathematics.

Ruth: Academia is changing because of economic factors, we must help shape the change to serve diverse communities better. Math skills are important to financial independence.

Mark: It is important that graduate students be aware of the full spectrum of their career options. The more confident those who enter graduate study in math can be that this is going to lead to a fulfilling career, the better. Being able to have this confidence is an important facet of creating a welcoming environment for students of all backgrounds. Opportunities in math are expanding-- for example, the Data Science track created jointly by math and stat at UCLA recently opened up, and this track for undergraduates is growing rapidly.

When I was involved with the Math 2025 report, we read a study that indicated that about half of the papers in math journals were coming from people who were not in academia. We should welcome members of the "Mathematical Diaspora" into our community, and value students who join them in pursuing non-academic careers. It is one ecosystem.

Dave: about 45% of math PhDs end up publishing 0 or 1 papers.

Catherine: When I was at the College of Holy Cross, I would ask my colleagues who they thought should go to grad school. They typically would focus on the students who got the best grades, rather than take a more holistic view to consider potential.

Mark: I saw an [article](#) listing the top 100 universities in terms of their impact on the social mobility of their students. In the top 10 were a couple of UC's, several California State universities, BYU Provo, and several other places. Measures like social mobility should count for more in evaluating colleges and universities.. There is a reorientation of perspective that we need. Community colleges were not considered for purposes of that article, which was just about universities--if they had been, they would have been well-represented throughout the list.

Jessica: Taking the perspective from statistics, we haven't talked about master's programs. These are popping up in Data Science. Unfortunately, often they don't involve much mathematics -- but they do involve a lot of coding. Also, ABET is coming up with an accrediting program for undergraduate Data Science programs. The ASA is getting involved in this.

Kathryn: Even for people in Math Ed, we hear from students on how horrible they are treated. There is a lot of snootiness in higher ed!

Jessica: At Irvine, our department (Statistics) has a monthly discussion on diversity issues. We have reading materials. A faculty member has been successful in getting this started and had a lot of support from the faculty. A lot of faculty live nearby in University Hills, and there have been some racial incidents. This has motivated many of us to talk about racial justice in the department (and the neighborhood).

Dave: We invited math chairs to talk about racial justice. We expected maybe 20 chairs, and we got more than 120 to join the discussion.

Catherine: I see this a lot with the AMS. Some people send me e-mails saying they want to quit the AMS because change is happening too fast, and others send e-mail saying they are upset that AMS is not moving fast enough!