

## Western Regional Meeting on Graduate Education: Highlights

Septembers 14-15, 2019

After several engaging and productive regional convenings related to upper-division mathematics pathways and teaching strategies and practices, graduate education for the first time was the focus of the latest regional TPSE Math meeting, held at the University of Southern California on September 14-15, 2019. Since the issue of graduate education has thus far received the least amount of attention of TPSE's four priority areas, the Western Regional Meeting provided participants the opportunity to help shape and guide current and future thinking about how graduate programs can better prepare students seeking careers not just in academia, but also in business, industry, and government. Further, participants raised questions related to the lack of diversity in mathematics and strategized ways to make graduate programs more inclusive.

The Western Regional Meeting helped both TPSE leadership and meeting participants to surface and distill the issues, opportunities, and challenges that exist in the field, in addition to helping TPSE determine what actions are most beneficial to the broader mathematics community. Over the course of two days, institutional stakeholders – including faculty, administration, and advisors – expressed concerns and opinions, engaged in strategic dialogue related to changing student demographics and workforce demands, and talked about how to turn those conversations into action.

### THEMES/ISSUES

Over the course of the meeting, four primary areas of interest emerged and became the focus of small-group breakout discussions to conclude the meeting: career paths, mentoring, diversity and inclusion, and the evolution of graduate education. Below is a summary of key points and select next steps related to these themes.

#### Career Paths

“Industry is starting to understand how valuable mathematicians are – well ahead of mathematicians themselves.” – Tom Marley, University of Nebraska - Lincoln

The question of what happens to students who do not follow an academic path was explored in a session devoted to career pathways. Several panelists and participants stressed the need for students to know the “bigger picture” outside academia. As Skip Garibaldi of the IDA Center for Communications Research explained, “Math by its nature is foundational” and helps “tie everything together.” Further, trained mathematicians can fill a myriad of economic and workforce needs, and helping students understand the economic value of mathematics programs moving forward is of extreme importance, as is conducting outreach and making connections with diverse populations who have traditionally been shut out of mathematics.

### What Can TPSE Do?:

Help mathematics departments develop strategies and procedures to keep in touch with alumni and take advantage of their knowledge and experiences, post-graduation. TPSE should additionally feature alumni in a panel discussion at a future meeting.

With technical assistance from TPSE, math departments will create structured and well-defined internships for students. TPSE can also convene workshops on building internship programs and opportunities that ensure graduate students gain the knowledge and skills they need post-graduation.

### Mentoring

“Students need to understand they won’t just sit in a library. They can be interacting with the broader world.” – Sheldon Axler, San Francisco State University

A key takeaway of the panel discussion regarding recruitment, retention, and mentorship was the idea that graduate programs need to be structured to “fit the student,” and not the other way around. Many felt that graduate programs should be more accepting of students who show promise, in addition to the “star” mathematicians. “Insularity will be the death of us,” noted Scott Wolpert from the University of Maryland, adding, “We need be seen as an essential partner” both inside and outside of the institution. Listening to students and incorporating their feedback into mentoring strategies was identified as another essential practice.

### What Can TPSE Do?

Convene a meeting on “mentoring the mentors” that includes vertically integrated institutional teams and input or participation from a social scientist who studies mentoring. Participants will prep for the meeting through background reading and research and come ready to develop actionable next steps at their respective schools.

### Diversity and Inclusion

“We need to recognize the beauty of the cultures that surround us, and the role that they can play in the teaching of mathematics.” – William Velez, University of Arizona

Mathematics as a discipline and a profession has long struggled with issues related to diversity and inclusion. Perhaps the liveliest discussions over the two days of the meeting revolved around how to diversify graduate math programs and ensure students of color are not “mistreated by math,” as the University of Arizona’s William Velez asserted during his presentation. Several participants indicated that the next generation of mathematicians should more closely resemble the growing diversity of the student bodies they will be mentoring and training. By keeping a diverse student population out of graduate math programs – whether unintentionally or by design – institutions are missing out on an important pool of talent. As several participants pointed out, in addition to providing versatile training

for a wide range of careers, mathematics can also serve as an engine of social mobility, which is why diversity and inclusion are so crucial to the well-being of students, institutions, and the communities they serve.

#### What Can TPSE Do?

Provide leadership and technical assistance to craft a “value statement” for department chairs and faculty, and institutional administrators that outlines responsible practices for enhancing diversity and inclusion within the discipline. Based on this statement, departments can then create recommendations and convene a diversity/outreach subcommittee to guide their efforts.

#### The Evolution of Graduate Programs

“What are we valuing [and] how do we get there? Are we producing the people who are the evolution of our program?” – Mark Green, University of California-Los Angeles

How graduate mathematics programs evolve to meet changing demands both inside and outside academia was the focus of the meeting’s final session. There was a consensus that math departments need to do a better job of demonstrating why getting a Master’s or Ph.D in mathematics is important. According to participants, highlighting the role of math in increasingly popular programs of study like data science or artificial intelligence is one possible strategy. Adapting to advances in the fields of mathematics and science is crucial if graduate mathematics education is to remain relevant. Students who earn an advanced degree in mathematics learn skills that prepare them for diverse and lucrative employment experiences in a number of fields – not just math. In addition to understanding the economic and intellectual value of a Master’s or a Ph.D in mathematics, graduate students need to feel supported and accepted in order to become better students, teachers, and workers. As William Massey from Princeton University observed, “A graduate student in your department is an ambassador for your department.”

#### What Can TPSE Do?

With input and direction from TPSE, departments and institutions can strengthen the pathways that connect Master’s students to Ph.D programs and explore the possibility of an NSF Research Experience for Master’s Students.

Help mathematics departments examine their admissions criteria and other selective steps such as preliminary exams and qualifying exams to ensure that they are well aligned with the department’s goals and that they assess skills required to succeed in the program. Departments must be intentional and transparent about these selection processes and establish support structures that facilitate student success.

With TPSE’s guidance, mathematics departments will learn from other disciplines and support students who wish to seek internships outside the math department.

## Conclusion

TPSE leadership is just beginning to contemplate how to shape future efforts related to graduate education and respond to changing academic and economic demands. As Phillip Griffiths pointed out in his summary of the meeting, a number of local initiatives and interventions are already taking place – the challenge is determining how to best scale those isolated innovations up to universal practice. With continued input from the larger mathematics community, TPSE can help to shape the future of graduate education and ensure it is relevant, inclusive, and supportive of student aspirations and goals.