OPINION

The PCMI Workshop for Mentors: A Weeklong Workshop on Diversity?

Angelynn R. Alvarez, Malena Español, Adel Faridani, Cynthia V. Flores, Alison Marr, Jenny McNulty, Elaine Newman, Rebecca Nugent, Alice Seneres, Martha Shott, William Y. Vélez, and Erica Walker

Note: The opinions expressed here are not necessarily those of Notices.

ABSTRACT. In what follows, the participants from the five-day workshop for mentors share their perspectives and lessons learned from the workshop. Participants and facilitators alike offer final thoughts in the form of recommendations for mathematics mentoring.

Before the workshop I wondered how one could spend an entire week talking about diversity in mathematics. During the course of the week I realized that we could actually only scratch the surface, that the topic is very complex and raises very similar questions to those that arise when thinking about overcoming prejudices and achieving equity and inclusion in society at large.

Angelynn Alvarez is assistant professor of mathematics at SUNY Potsdam. Her email address is alvarear@potsdam.edu.

Malena Español is assistant professor of applied mathematics at The University of Akron. Her email address is mespanol@uakron.edu.

Adel Faridani is professor of mathematics at Oregon State University. His email address is faridani@oregonstate.edu.

Cynthia V. Flores is assistant professor of mathematics at California State University Channel Islands. Her email address is cynthia.flores@csuci.edu.

Alison Marr is associate professor of mathematics at Southwestern University. Her email address is marra@southwestern.edu.

Jennifer McNulty is associate dean of the College of Humanities and Sciences at the University of Montana. Her email address is Jenny.McNulty@umontana.edu.

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167Elaine Newman is professor of mathematics at Sonoma State University. Her email address is elaine.newman@sonoma.edu.

Rebecca Nugent is associate department head and director of undergraduate studies in the department of statistics & data science at Carnegie Mellon University. Her email address is rnugent@andrew.cmu.edu.

Alice Seneres is director of Integrated Academic Support Programs at Rutgers University. Her email address is alice.seneres@rutgers.edu.

Martha Shott is assistant professor of mathematics at Sonoma State University. Her email address is shott@sonoma.edu.

William Y. Vélez is Distinguished Professor of Mathematics at the University of Arizona. His email address is velez@math.arizona.edu.

Erica Walker is professor of mathematics education at Teachers College, Columbia University. Her email address is ewalker@tc.edu.

Figure 1. Participants in the Workshop on Increasing Minority Participation in Undergraduate Mathematics at the 2017 IAS/Park City Mathematics Institute. Back row: Rafe Mazzeo (Director), Adel Faridani, Alice Seneres, Rebecca Nugent, Alison Marr, Malena Español, Angelynn Alvarez. Front row: Jenny McNulty, Cynthia Flores, Elaine Newman, William Vélez (Workshop Facilitator), Martha Shott, Erica Walker (Workshop Facilitator).

The weeklong workshop for mentors has been part of the three-week Park City Mathematics Institute (PCMI) since 2013. Facilitated by William Vélez and Erica Walker this year, the workshop had ten participants; see Figure 1.

Workshop activities included presentations, panels, and readings. In addition, participants developed action plans to address diversity and equity at their institutions and crafted letters to incoming students to attract them to the major. During its three-week duration, PCMI runs several different programs at the same time,[1] aimed at different sectors of the mathematical community. Throughout PCMI, efforts are made to establish communication between the different groups:

> During the week that our group was at PCMI, there were a couple of lunches that the conference organizers "socially engineered" to get people from the different groups to mingle. After getting my food, I sat down at the randomly assigned table and introduced myself to the others: I told them my name, my institution, and that I was a part of the Diversity workshop. Their eyes would flicker with interest. "That workshop sounds really fascinating," they'd say, or perhaps, "I really want to attend that workshop one of these years." And then, after the initial excitement, they would flounder a bit. "So…what do you all talk about in that workshop?"
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> These introductions speak to the fact that other mathematicians are hungry for information about the challenges that underrepresented students face, and how to best support them—but as is often the case, we (as a community) often make the choice to postpone the discussion for another day in lieu of something that may "better serve our careers" at the current time (e.g., participating in a research group focused on our particular branch of mathematics).

Conversations about diversity are a rarity in mathematics departments, and often minority mathematicians may be reluctant to openly discuss their experiences in the mathematical enterprise. Several of these discussions naturally came up during our workshop.

> I, as a majority white mathematician, feel that I am inviting students in to the mathematics community when I encourage them to become mathematics majors. But some of our minority students may feel that to join the mathematics higher-education community, they will need to leave behind their home community. My minority students may not want to be "just like me"! We need to let them know that there are many diverse ways to be a mathematician.
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> We learned about several examples where minority mathematicians either felt subtly excluded or felt pressure to assimilate. For example, upon entering the classroom on the first day of classes, being asked: "Are you sure you are in the right room? This is a PDE seminar." My interactions with every student will be approached with a greater degree of humility and openness.
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> Many mathematicians are puzzled when the issue of diversity is brought up. "Math does not discriminate, it is black and white with no in-between," they counter. The issue isn't math, it's people. Our students are not all the same, they come to us with their own set of skills, hopes, dreams and issues—many of which are formed by our society. Do we think our society is equitable? Some students won't even get to attend college because of where they are born, regardless of their skill. How many Ramanujans might be out there? How many Dorothy Vaughans (*Hidden Figures*) have gone unrecognized and underappreciated?
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> As a faculty member working with Native American students, I am cognizant of many similarities and differences. Many of our students have grown up on a reservation and have had similar issues to that of author Sherman Alexie,[2] who as a young child learned to cope with alcoholic parents. Other students have grown up in a culturally rich, family-centric supportive home. Yet both of these groups of students feel like outsiders when they attend

[1] *See* `pcmi.ias.edu` *for details.*

[2] *Alexie wrote, for example,* The Absolutely True Diary of a Part Time Indian (2007).

university; they are from a different culture. What are we doing about this?

Students are best served by seeing the conscious work and effort of an entire department reaching out to help them. The work to serve the students can't be marginalized or compartmentalized. Our university tenure and promotion policies must explicitly recognize the value of the intensive work involved in the outreach to underserved and under-represented minority students.

An early activity of the workshop was to create a letter of invitation to incoming students informing them of the importance of mathematics in their studies and inviting them to become mathematics majors. All participants

Figure 2. Participants drafted letters to prospective majors and crafted action plans.

crafted letters, though sometimes they targeted different audiences. In addition to the letters participants were asked to craft "action plans" (see Figure 2).

One of the most valuable components of this workshop is that I walked away with immediate action items for my university that were zero cost. The email letters we drafted for incoming students is an easy no-cost item. We also read many relevant and engaging articles related to diversity that could be used as a topic at a faculty meeting, math club, or as part of a classroom conversation. We also discussed making updates to our departmental website to have more information about our graduates, more diverse photos and videos of our current faculty and students, and clearer information about our majors. All three of these action items would help in the recruitment and retention of a more diverse undergraduate math population, yet can be done with little to no financial cost.

While it is easy to think that it is not necessary to email every prospective student, because a student who is truly interested will self-identify, in truth there are many reasons a student may be hesitant to reach out or simply not even consider themselves a good match for the field. Many, many things in life are decided due to the external influence—positive or negative—of society, family, or friends. An email inviting students to consider a certain course of study is adding another voice.

An invitation that focuses on missing populations may seem unnecessary, but change won't happen overnight. It will be challenging to hold the door open when you don't see someone approaching. If you are willing to be an agent of change, join a network of faculty who share your philosophy.

There is evidence that committed faculty (in particular, department chairs) with a willingness to engage and support students can result in substantial success of minority students (see, for example, [5]). But the results of diversity initiatives may take years to appear and support for these initiatives should be viewed as long-term commitments. As one participant stated:

"There are deeper issues that appear to require the rethinking of longheld assumptions."

While we exchanged many good ideas that can be implemented quickly and will do some good right away, there are also deeper issues that appear to require the rethinking of long-held assumptions, and consistent efforts by a dedicated and growing group of people, exerted over a long period of time, in order to be resolved. This became particularly evident to me when we read and discussed the 1996 article "The Challenge of Diversity" by Etta Falconer, which examined the reasons for the persistent under-representation of African Americans, Hispanics, and Native Americans in mathematics. Falconer acknowledged that since the 1960s extraordinary efforts had been made to increase the participation of minori-

> ties and women in the scientific and technical workforce, and that the advocates of this movement in the 1960s could not have imagined that after 30 years [by 1997] this massive disparity would still exist. Our group felt that it would be very interesting to see a current update of the data that Falconer presented. Our initial impression was that most likely not much has changed in the additional 20 years since the article appeared. Falconer attributed the disparity to "the existence of unfavorable conditions in American society and in the culture and actions of the mathematics community." While some of these unfavorable conditions are obvious to many, others may not be, and their recognition may require an opportunity for reflection such as this workshop provided for our group.

In the latest report of doctoral recipients [4] it was reported that 56 out of 1,901 doctorates in the mathematical sciences in 2014–2015 were minorities. That is less than 3%! After so many years of addressing diversity in this country, 4 American Indian or Alaska Native, 20 Black or African American, 26 Hispanic or Latino, and 6 Native Hawaiian or Other Pacific Islander survived the rigors of graduate education in the mathematical sciences. Graduate programs complain that there is a paucity of minority applicants. Yet we discovered that there were 3,100 bachelors degrees in mathematics awarded to minorities and it was estimated that, of these, 192 were accepted into graduate school [1]. There is no lack of interest in the minority community for mathematics but there appears to be a lack of attention to them from the mathematical sciences graduate programs.

> Are we unintentionally turning off certain populations from our discipline? What are those micro-aggressions [see, for example, [2]] that lead large groups of people to turn to other disciplines? Are we reinforcing a culture that values individual efforts and not community efforts?

The title, *Workshop for Mentors*, gives importance to the interaction between instructor and student, and this topic was pervasive in our conversations throughout the week.

> First, I've learned that increasing minority student representation in mathematics majors and careers requires aggressive hands-on advising and mentoring. During the PCMI, a panel of [undergraduate and] graduate students talked with us about why they persisted in studying mathematics and why they chose the particular graduate programs they did. As undergraduates, a faculty mentor encouraged them to do research projects and attend REUs or other programs in the summers. The students told us that they picked graduate programs because of the special attention of the graduate chair of that department.
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> I initially wondered: does it take special skills to do this kind of mentoring? We had the opportunity to have a Skype conversation with Leticia Williams at the NOAA Center for Atmospheric Sciences, and Talitha Washington of Howard University. Williams counseled us to let students know they have an ally in us, to verbalize specific things that a student does well, and to make a contract with students that includes long-term goals or even time spent on homework. I left the workshop realizing that I had to be more assertive about reaching out to students, instead of waiting for them to come to me.
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> Several of the mathematicians that we heard from via readings or conference calls alluded to the fact that most minority students do not take full advantage of office hours, tutoring services, etc., because they may not feel entitled to those services, and/or they may not feel comfortable in those environments. So from now on, I am going to be extremely proactive in reaching out to students, whether they are obviously struggling or not, to discuss their study habits and encourage them to seek help as often as they need.

"From now on I am going to be extremely proactive in reaching out to students."

There were issues that minority students often face when they arrive at college. As we all know, students who are not prepared for college level mathematics must take remedial or development courses. These courses can present barriers to STEM careers.

> I learned that many students in underrepresented groups that were placed in developmental math might see math as a "dead end" and end up not taking more math classes. It would be constructive for faculty to send the message that such courses are not dead-end courses, and that when one takes more math in college, they start opening doors to careers.

Recommendations

1. Make action plans to promote diversity.
2. Design all mathematics classes to encourage students to "take the next math course" [3].
3. Write to students inviting them to become mathematics majors.
4. Make the mathematics major relevant to the career goals of students.
5. Improve advising and mentoring beyond standard office hours.

References

[1] T.H. Barr, J.W. Maxwell, and W.Y. Vélez, Recent trends in bachelors degree recipients in mathematics at US institutions. *Notices Amer. Math. Soc.* **63** 2016 (6), 660-665.

[2] D.W. Sue, (2010). *Microaggressions in everyday life: Race, gender, and sexual orientation.* Wiley & Sons, 2010.

[3] W.Y. Vélez, Flexibility in the mathematics major would benefit students and society. *Notices Amer. Math. Soc.* **64** (9), 992-993.

[4] W.Y Vélez, J.W. Maxwell, and C.A. Rose, Report on the 2014-2015 new doctoral recipients. *Notices Amer. Math. Soc.* **63** 2016 (7), 754-765.

[5] E.N. Walker, *Beyond Banneker: Black mathematicians and the paths to excellence.* Albany, NY: SUNY Press, 2014.

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ABOUT THE AUTHORS

Angelynn R. Alvarez

Angelynn R. Alvarez earned her PhD in May 2016 from the University of Houston in Houston, Texas. Her research interests lie in the fields of differential geometry, algebraic geometry, and complex analysis. She enjoys baking, traveling, eating spicy foods, and enjoying the great outdoors of upstate NY.

Malena Español

Malena Español's research interests are in numerical analysis, numerical linear algebra, and applied and computational mathematics. Her research consists of designing and analyzing numerical methods for problems arising in materials science and image processing. When she is not doing math, she enjoys playing with her husband, Agustin, and their son Sebastian.

Adel Faridani

Adel Faridani studied physics and applied mathematics in Germany before joining Oregon State University in 1989. His research interests include computed tomography and Shannon sampling theory.

Cynthia V. Flores

Cynthia V. Flores completed her PhD in PDEs at UC Santa Barbara in 2014 then joined the faculty at CSU Channel Islands, where she enjoys teaching differential equations and supervising undergraduate research. She is dedicated to continuing the efforts of her inspirational mentors in creating opportunities for diversity within the mathematics community.


Alison Marr

Alison Marr has been at Southwestern University since 2007 and is currently Chair of the Mathematics and Computer Science Department. She enjoys teaching mathematics at all levels including more interdisciplinary courses like her First-Year Seminar on television game shows. In her free time, she enjoys playing saxophone and traveling.


Jenny McNulty

Jenny McNulty is a combinatorist who uses her mathematical problem-solving skills in a variety of ways in her role as an academic administrator. When not at work, she enjoys the outdoors of Montana—the rivers, mountains, and ice hockey rinks.


Elaine Newman

Elaine Newman received her PhD in probability theory from UCLA. In addition to her passion for teaching and learning mathematics and statistics, she is chapter president of her union, the California Faculty Association, at Sonoma State.


Rebecca Nugent

Rebecca Nugent received her Bachelor's in Mathematics, Statistics, and Spanish from Rice University, her Master's in Statistics from Stanford University, and her PhD in Statistics from the University of Washington. Her research is primarily in clustering and classification methodology development. She is also very active in statistics and data science curriculum and program development.


Alice Seneres

Alice Seneres earned her PhD in Mathematics Education, and her previous careers include being a mechanical engineer and teaching college mathematics. She oversees the Learning Assistant Program at Rutgers University, and her research interests are peer education and active learning.


Martha Shott

Martha Shott's primary research interests are in mathematical models of freeway traffic flow and in interdisciplinary STEM education at the undergraduate level. Outside of academia, she enjoys running, cooking plant-based meals, and playing soccer.


William Y. Vélez

William Y. Vélez is soon to be emeritus.


Erica Walker

Erica Walker earned her doctorate in education from Harvard University in 2001. The author of two books, one of which is a study of mathematicians in the United States (*Beyond Banneker: Black Mathematicians and the Paths to Excellence,* published by SUNY Press), she is fond of museums and finding mathematics in everyday and unusual spaces.