American Mathematical Society
Committee on Education Meeting
October 13-15, 2016
Washington DC

Summary

The focus of this year's AMS Committee on Education meeting was on "Broadening the Conversation: Engaging other STEM Education Stakeholders." The meeting itself consisted of presentations and discussions over a day and a half. Attendees included a number of chairs of departments of mathematics from across the country. Douglas Mupasiri, Chair of COE, introduced the speakers and facilitated the meeting.

Education Activities of the American Physical Society
Ted Hodapp (American Physical Society-APS) began his presentation by talking about the guiding principles of APS education and diversity programs. He noted problems facing physics today including a lack of high school physics teachers, a lack of diversity (racial/ethnic and gender), and adapting evidence based pedagogical techniques in the classroom.

Hodapp then talked about the statements on these issues that APS publishes and also about some of the APS programs designed to address these concerns. Specifically, he discussed PhysTEC and the APS Bridge Program. PhysTEC is a partnership between APS and the American Association of Physics Teachers (AAPT) designed to improve and promote the education of future physics teachers.

The APS Bridge Program is an effort to increase the number of physics PhDs awarded to underrepresented minority students. The program utilizes a national network of doctoral granting institutions that provide mentoring for students to help them successfully complete their PhD programs. The program provides selected institutions (Bridge and Partnership Sites) with funding to build bridge programs and improve mentoring efforts.

Hodapp talked about the APS Conferences for Undergraduate Women in Physics (three day regional conferences for undergraduate physics majors) and also about their mentoring programs.

ACS Education Division: Resources supporting learners and educators
Nancy Bakowski (American Chemical Society-ACS) started by giving some background on ACS and its education division. She then discussed ACS education programs including the American Association of Chemistry Teachers (AACT), K-12 programs, higher education and scholars programs, and ACS awards and committees.

AACT is a national organization that supports K-12 teachers of chemistry with customized resources and professional development opportunities. The K-12 programs that were discussed included Project SEED, which offers summer research experiences to economically disadvantaged high school students, and the U.S. Chemistry Olympiad, a multi-tiered chemistry competition from which the top four students also compete on the international level.

Bakowski also talked about the ACS Scholars Program, which awards renewable scholarships to underrepresented minority students who want to work in chemistry or chemistry-related fields. She also mentioned their student chapters program and support for graduate students and post docs. Additional programs discussed included the Next Generation Science Standards (NGSS) and ACS Approval program.

Transforming Post-Secondary Education in Mathematics: An Update on our Activities
Tara Holm (Cornell University) presented an update on the work of the Transforming Post-Secondary Education in Mathematics (TPSE Math) group, including their strategic priorities and action plan. She discussed the renewed federal interest in higher education in general and in undergraduate STEM in particular and how time is of the essence in creating sustainable change in these areas.

TPSE Math's vision for the future is to make it so that 'post-secondary mathematics education will enable any student, regardless of his or her chosen program of study, to develop the mathematical knowledge and skills necessary for productive engagement in society and in the workplace.' The group has incorporated and has set up an administrative center at the University of Maryland.

TPSE Math strategic priorities include coherent pathways (lower division), enhanced/alternative pathways (upper division), new teaching strategies and graduate education. They are addressing these priorities in a few different ways including through the launch of a Mathematics Advisory Group that is mobilizing department chairs and also by building an action network beyond the math community.

Holm conducted some small group discussion among meeting attendees to discuss ideas for how TPSE and the AMS might support transformation in post-secondary education. Further discussion focused on a permanent AMS liaison to TPSE, stronger partnerships between TPSE and other groups and creating a clearinghouse for active learning programs and instructional practices.

Developing the open source on-line homework system WeBWorK within academia
Michael Gage (University of Rochester) began his presentation by describing the open-source online homework system known as WeBWorK. It is supported by the Mathematical Association of America (MAA) and the National Science Foundation (NSF) and was designed as an experimental platform which has evolved over 20 years into a tool used in 750 institutions. It utilizes the Open Problem Library (OPL), a curated collection of 30,000 math homework problems contributed by many faculty.

WeBWork strives to make homework more effective and efficient by providing students with immediate feedback on their answers and giving them the opportunity to correct mistakes in the moment. It was developed and is maintained by mathematicians and offers flexibility and extensibility.
Gage provided some problem examples and discussed WeBWork's goals and key features. He also discussed the program's significant impact and how open-source software has become an increasingly important part of education and research.

Gender disparity in STEM and the Role of Calculus
Jess Ellis (Colorado State University) spoke to the group about gender inequality in STEM, why it's important to note and how examining calculus persistence helps identify the problem. She began her presentation by discussing the leaking STEM pipeline and how Calculus I is often to blame. She referred to the Characteristics of Successful Programs in College Calculus project, a national survey by the MAA and supported by NSF that examines successful calculus programs. This survey identifies factors that are correlated with success in Calculus I including confidence and interest in mathematics, positive (or neutral) changes in enjoyment, and persistence to Calculus II.

Ellis presented data on men and women in the STEM pipeline over time and identified the disparity between them at different stages of their education even with similar interest in science and math early on. The data showed significant drop off of women continuing in STEM after completion of Calculus I. Surveys of students taken before and after Calculus I determined that women are not going on to Calculus II because of their lack of confidence and not their lack of ability.

With Calculus I giving insight into the experience of women, Ellis suggested solution strategies to address gender inequality in STEM that would include increasing the pipeline flow by involving young women in STEM earlier in their math career in an effort to increase their confidence, and also decreasing pipeline leaks by viewing introductory STEM courses as opportunities to increase confidence.

Bootstrap: A Unique Approach to Teaching Algebra through Programming

Emmanual Schanzer (founder and creator of Bootstrap) began his presentation by talking about the importance of algebra and how computer science can help student success in this subject. He described the Bootstrap program and how it teaches mathematical concepts through computer programming.

Currently reaching 15,000 students annually, Bootstrap is a curricular module for students ages 12-16, which teaches algebraic and geometric concepts through computer programming. It integrates algebra with computing fostering student growth in both subjects. Bootstrap can be integrated into a standard math class and provides complete lesson plans, student materials, software and teacher-training workshops. Lessons are aligned to state and national standards and are continually assessed for student math achievement.

Schanzer explained there are other Bootstrap programs as well, one for data structures, one dealing with lightweight data science and another with physics.

The Enriched Doctoral Training in the Mathematical Sciences (EDT) Program

Tie Luo (National Science Foundation) began by presenting some history of the Workforce Program at NSF's Division of Mathematical Sciences (DMS). He went on to discuss current DMS Workforce Programs including the Enriched Doctoral Training (EDT Program.

The goal of EDT is to enhance doctoral training in the mathematical sciences and to prepare doctoral students for a wide range of career paths. The program is in its third year with two awards having been given in 2015 and four awards in 2016. The 2017 proposal deadline date is in July.

Luo mentioned the Mathematical Sciences Graduate Internship program that is coming soon. This program will be done through the Oak Ridge Institute for Science and Education (ORISE) and is aimed at students interested in using advanced mathematical and statistical techniques to address world problems.

New Instructor Training at UMich: Promoting Engaged Learning

Gavin LaRose (University of Michigan) began with a history of the University of Michigan's new instructor training efforts over the past 35 years. He then spoke to their current training methods, the program's scope and its focus on active learning.

New instructors, mostly graduate students and post docs, receive one full week of training before regular classes begin. After training week, each new instructor is supported with day-by-day lesson plans, instructor meetings, class visits and midterm evaluation surveys. LaRose noted that they produce 50-65 new instructors each fall.

The training program addresses how to lecture, what to do with problem students and teaching logistics. Reasonable salaries are offered to new instructors in the program, who almost exclusively teach Pre-calculus and Calculus I. Class sizes are small and courses, homework and exams are uniform.

A Preceptor Program: Taking an Aim at Excellence in Introductory-Level Calculus Instruction
Robin Gottlieb (Harvard University) started by discussing the history and evolution of the Harvard preceptor program and its key elements. Established in 2000, the preceptor program allows Harvard to address the challenges of creating a successful calculus program.

Gottlieb talked about how preceptors impact calculus teaching and their importance to the coordination and administration of courses. She also discussed professional development and how they prepare graduate students to teach by conducting mandatory pedagogy courses for first year grad students, then teaching apprenticeship and calculus coaching programs.

Gottlieb reported that hiring challenges are a notable issue and that support for the program among department faculty is critical for successful implementation. She also discussed additional work that preceptors are doing and outlined some positions that former preceptors have taken.

Building Bridges to Belonging: Mindsets That Increase Participation, Achievement, and Learning in Math
Catherine Good (Baruch College, CUNY) defined a '*stereotype threat*' as "an unpleasant apprehension arising from the awareness of a negative ability stereotype in a situation where the stereotype is relevant and thus confirmable." She then examined this threat's ability to undermine the success of individuals in the learning process, particularly gender, race and ethnicity stereotypes that impact an individual's success in mathematics.

She explained that the impact of a *stereotype threat* does not come from the person's belief in the stereotype itself, but rather that simple awareness of a *negative stereot*ype is a burden to the individual that can change performance. Conversely, knowledge of a *positive stereotype* can cause a lift in performance. *Negative stereotype* not only questions a person's ability but also impact's their sense of belonging so that even if performance is high, the sense of belonging is low and the person becomes less engaged.

Good discussed ways in which vulnerability to a *stereotype threat* can be reduced including: 1) encouraging a growth mindset -- believing that intelligence can be developed and is not fixed (this for students as well as faculty/department/discipline) ; 2) encourage belonging based on effort/engagement – creating a classroom learning environment that values effort and engagement as a path to belonging; and 3) re-attribution for difficulty – encouraging students to attribute their difficulties to causes other than their own limitations.

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