Reflections on the AMS Committee on Education

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The AMS, founded in 1888 to further the interests of mathematical research and scholarship, serves the national and international community through its publications, meetings, advocacy and other programs.

- Over 30,000 members
- Roughly 12,000 graduate student members
  (the vast majority are nominated by institutions)

**Governance**
- Executive Director based in Providence
- Additional offices in Washington DC and Ann Arbor, MI
- Elected officers, Council, Board of Trustees
- Dozens of Committees ([http://www.ams.org/committee-nominate](http://www.ams.org/committee-nominate))
New in 2016: Office of Education and Diversity

Current Programs include

- AMS Epsilon Fund
- Blog on Teaching and Learning Mathematics
- Graduate Student Travel Grants, Student Chapters, Blog
- Math in Moscow Travel Grants
- Mathematical Moments
- Math Research Communities

October 14-15, 2016: AMS Committee on Education
I think this worked:

**Community.**
- Broaden + deepen representation.
- Intentional *community building:*
  - Mathematistas
  - (CM)², Math Circles
- Collaboration, not competition.

**Constant affirmation and support.**
- Listen and learn.
- Care. Show you care.
- Create a safe environment.
- Encourage introspection.
  - Growth mindset, impostor syndrome.

**High quality mathematics.**
- We need a strong, active, connected research environment.

**Focus on strengths, not weaknesses.**
- (Growing and harvesting) vs (selecting and weeding out).
7 Common Features of Calculus Programs at Selected PhD Granting Institutions

• 1- Rigorous courses
• 2- Attention to local data
• 3- GTA professional development
• 4- Supporting teaching and active learning
• 5- Coordination
• 6- Learning resources
• 7- Placement
Student Engagement

ASA DataFest: This event is a celebration of data in which teams of undergraduates work around the clock to find and share meaning in a large, rich, and complex data set. After two days of intense data wrangling, analysis, and presentation design, each team is allowed a few minutes and no more than two slides to impress a panel of judges. Prizes are given for Best in Show, Best Visualization, and Best Use of External Data.

Reach: National College and University students, faculty and supporters. Event size varies approximately 30 undergraduate students per event (200+ students in 2015).

Target Audience: Undergraduate statistics students and interested community members

www.amstat.org/education/datafest/
BIG Math Network

- **Faculty ambassadors** sharing information about opportunities and best practices, providing training, mentoring
- **BIG partners** posting opportunities and communicating about the role of the mathematical sciences in their work
- **Students** seeking opportunities
- Mathematical Sciences **Societies** (17) disseminating information to members
- **Chairs/Grad directors** supporting local efforts
- **Institutes** hosting workshops and training
- **Regional hubs** creating opportunities
Now is the time to focus on mathematics at the undergraduate and graduate level

- Mathematics is essential in the preparation of the STEM workforce
- The nature and practice of science is becoming computationally intensive and data-driven across most fields
- New technologies and new understandings about learning and teaching allow new possibilities for instruction.
- If mathematics departments don’t own the problem, someone else will.
Summary

• Written vs. oral comments
  – Dr. A presented the most important content of the proof orally.
  – Students only recorded written work in their notes.

• Beliefs about proof
  – Dr. A attempted to convey the overarching method of the proof and an important heuristic for writing proofs.
  – Most math majors think understanding a proof consists of knowing how new assertions were derived from previous assertions, but do not concentrate on the methods used in the proof.

• Colloquial mathematics
  – Students did not attend to Dr. A’s use of the word “small” and did not appear to know what he meant by this.
Heterogeneity analyses indicated no statistically significant variation among experiments based on the STEM discipline of the course in question, with respect to either examination scores (Fig. 2A; $Q = 910.537, df = 7, P = 0.160$) or failure rates (Fig. 2B; $Q = 11.73, df = 6, P = 0.068$). In every discipline with more than 10 experiments that met the admission criteria for the meta-analysis, average effect sizes were statistically significant for either examination scores or failure rates or both (Fig. 2, Figs. S2 and S3, and Tables S1A and S2A). Thus, the data indicate that active learning increases student performance across the STEM disciplines.

For the data on examinations and other assessments, a heterogeneity analysis indicated that average effect sizes were lower when the outcome variable was an instructor-written course examination as opposed to performance on a concept inventory (Fig. 3A and Table S1B; $Q = 10.731, df = 1, P << 0.001$). Although student achievement was higher under active learning for both types of assessments, we hypothesize that the difference in gains for examinations versus concept inventories may be due to the two types of assessments testing qualitatively different cognitive skills. This explanation is consistent with previous research indicating that active learning has a greater impact on student mastery of higher- versus lower-level cognitive skills (6–9), and the recognition that most concept inventories are designed to diagnose known misconceptions, in contrast to course examinations that emphasize content mastery or the ability to solve quantitative problems (10). Most concept inventories also undergo testing for validity, reliability, and readability.

Heterogeneity analyses indicated significant variation in terms of course size, with active learning having the highest impact on courses with 50 or fewer students (Fig. 3B and Table S1C; $Q = 6.726, df = 2, P = 0.035$; Fig. S4). Effect sizes were statistically significant for all three categories of class size, however, indicating that active learning benefitted students in medium (51–110 students) or large (>110 students) class sizes as well.

When we metaanalyzed the data by course type and course level, we found no statistically significant difference in active learning's effect sizes when comparing (i) courses for majors versus nonmajors ($Q = 0.045, df = 1, P = 0.883$; Table S1D), or (ii) introductory versus upper-division courses ($Q = 0.046, df = 1, P = 0.829$; Tables S1E and S2D).

Fig. 2. Effect sizes by discipline. (A) Data on examination scores, concept inventories, or other assessments. (B) Data on failure rates. Numbers below data points indicate the number of independent studies; horizontal lines are 95% confidence intervals.
Proposal to CBMS from the members of the AMS Committee on Education
15 November 2015

The members of the AMS Committee on Education propose that CBMS, or interested organizations within CBMS, create a statement of support for the use of active learning techniques in mathematics education. We propose that this statement have a structure similar to the joint MAA-NCTM position statement on calculus, consisting of a one-page summary statement together with a 5-10-page background section giving a more detailed justification for this position. We propose that this statement be coauthored by members of several CBMS-affiliated organizations to ensure that a broad range of mathematicians involved in postsecondary teaching are represented by the statement. Such a statement would serve as a clear public declaration that the mathematical community is actively working to improve the mathematical learning of all students. Further, it would provide mathematicians in leadership positions with support from the professional societies as they advocate for directing resources to the improvement of postsecondary mathematics education.

Below are some key references and a sample one-page summary statement that was considered by the AMS Committee on Education at the meeting of October 29-31, 2015.

References

MAA-NCTM joint calculus statement:
Recommendations include:

- Adoption of empirically validated teaching methods
- A national experiment in post-secondary mathematics education
- Diversifying pathways to STEM careers

AMS Response: Notices, Advocacy
The Mathematical Sciences in 2025
Postsecondary education in mathematics will enable any student, regardless of chosen program of study, to develop the mathematical knowledge and skills necessary for productive engagement in society and in the workplace.

TPSE Math will facilitate an inclusive movement to strengthen postsecondary education in mathematics. We will identify innovative practices where they exist, advocate for innovation where they do not, and work with and through partners to implement and scale effective practices.
Partnerships and initiatives

- **Curriculum pathways**
  - Through partnerships

- **Leadership capacity and development**
  - Convene and coordinate Department Chairs and Leaders
  - Mathematics Action Group

- **Graduate training**
  - Our future faculty!!
  - Longer term. Input very welcome!
Thank you

http://www.tpsemath.org