Collective Action: Why the Future is Brighter for Undergraduate Teaching in the Mathematical Sciences

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Collective Action: Why the Future is Brighter for Undergraduate Teaching in the Mathematical Sciences

By Karen Saxe, Professor, Macalester College, and Principal Investigator “A Common Vision for the Undergraduate Mathematics Program in 2025” [NSF DUE-1446000]

A remarkable event took place a few weeks ago at the Alexandria, Virginia headquarters of the American Statistical Association. Leaders from five professional associations whose missions include teaching in the mathematical sciences came together to guide future progress to incrementally improve education in our fields. It is the first time that all five — the American Mathematical Association of Two-Year Colleges (AMATYC), the American Mathematical Society (AMS), the American Statistical Association (ASA), the Mathematical Association of America (MAA), and the Society of Industrial and Applied Mathematics (SIAM) — are working together. Our focus is the collection of credit-bearing mathematics courses a student might take in the first two years of college. We examine the undergraduate program using a wide-angle lens, inclusive of modeling, statistics, and computational mathematics as well as applications in the broader mathematically based sciences.

Why now?

Each year approximately 50 percent of students fail to pass college algebra with a grade of ‘C’ or better.[1] Failure rates under traditional lecturing are 55 percent higher than the rates observed under active learning.[2] Undergraduate education in the mathematical sciences is in crisis in the United States. This crisis will affect all mathematical scientists at post-secondary institutions, regardless of each individual’s level of interest in education.

The crisis in mathematical sciences education is well documented in high-profile reports such as the U.S. government’s PCAST report on STEM education and the National Academies’ report on The Mathematical Sciences in 2025. In response (or in some cases, in anticipation of) these reports, various mathematical science associations have on their own or in collaboration released reports such as

1. Committee on the Undergraduate Program in Mathematics Curriculum Guide [3]
2. Modeling Across the Curriculum
3. Undergraduate Degree Programs in Applied Mathematics
4. Partner Discipline Recommendations for Introductory College Mathematics
5. Beyond Crossroads
6. Guidelines for Undergraduate Programs in Statistical Science
7. Guidelines for Assessment and Instruction in Statistics Education

There have been, and continue to be, many successful initiatives aimed at addressing the challenges identified. However, we believe it is time for collective action. We can no longer say, “I don’t teach those classes,” or “I don’t teach those students,” because students are now more mobile than ever, transitioning between multiple postsecondary institutions. For example, the National Student Clearinghouse Research Center’s Two-Year Contributions to Four-Year Degrees report found that 46 percent of all students who completed a degree at a
four-year institution in 2013-14 had been enrolled at a two-year institution at some point in the previous 10 years. Research on “collective impact” suggests that, in achieving significant and lasting change in any area, a coordinated effort supported by major players from all existing sectors is more effective than an array of new initiatives and organizations.[4]

To maintain a viable workforce for our country, to continue the expansion of scientific knowledge, and to remain relevant, we must update our curricula, make current our pedagogical methods, connect more strongly to other disciplines, and perhaps even evolve the culture of our own discipline. Many in our own community predict that if we do not achieve large-scale improvement in undergraduate education on our own, then markets, governments, or other structures will force change upon all of us. We believe it is better to have agency in making the necessary changes.

Ben Braun's recent blog post, which gives an account of the October 2014 AMS Committee on Education (CoE), states that “the most prominent theme of the meeting was the critical role of collaboration and cooperation at many levels: among department members, at the institutional level among departments and administrative units, among professional societies with common missions, and at the national level to ‘scale up’ successful models for effective teaching.” It is very good news indeed that important stakeholders are involved. A group of prominent mathematicians has come together to form Transforming Post-Secondary Education (TPSE Math) and they have recently published their first report. The umbrella organization for professional associations in the mathematical sciences, the Conference Board of the Mathematical Sciences (CBMS) held its forum on the first two years of college math, and is discussed by Diana White in her November 2014 blog post. Common Vision brings together the five professional associations whose missions include teaching in the mathematical sciences; it is our view that bringing association leadership together to work on undergraduate education is critical for lasting change.

Collective action to improve teaching and education in the mathematical sciences appears to be gaining traction.

Who was at the workshop?

The Common Vision 2025 project encourages action by highlighting existing efforts and draws on the collective wisdom of a diverse group of stakeholders to articulate a shared vision for modernizing the undergraduate mathematics program. We embrace the diversity of experience of our members.

Workshop participants included AMS President Robert Bryant, as well as several current and past presidents of all five associations. Participants also included faculty members from large departments at research universities; a statistician working at Google; a mathematician working at an HBCU; a vice president from the New York Hall of Science; faculty members from liberal arts colleges; faculty members from large comprehensive universities; the Executive Vice President of the APLU; a chemist working at the American Chemical Society; and an Achieving the Dream project director.

What can you do?

In reaching out to the membership of the five associations (including through this blog post) we hope to galvanize our colleagues and spur on a grassroots effort to improve education in the mathematical sciences.

Read the reports listed above. Read the Common Vision report, which will appear later this year and identifies common themes found in the above reports in order to provide a snapshot of the current thinking about
undergraduate mathematics and statistics programs. Our report will also include a list of project ideas generated at our workshop. For example, you might identify a part of your curriculum that you would like to change in some way (like the calculus sequence, or the collection of upper level analysis courses, or the courses that do not require calculus and are intended for non-majors), and organize a meeting this summer with your colleagues about it; in advance, start a Google document where you can share ideas. Small changes, including more care and intention about our curriculum, can help our students have a better classroom experience. The activities are ones where we deem “small wins” are realistic, and are aimed at updating the mathematical sciences curriculum, updating pedagogical methods to align with best practices, and changing the culture of our discipline.

Please, do something. Do something. Do something.

The Common Vision website: http://www.maa.org/common-vision


