

Opportunities to Transform Post-Secondary Education in the Mathematical Sciences And the Role of TPSE Math

1: Transforming Mathematics from Barrier to Gateway

- On behalf of TPSE, let me add my own welcome, and our thanks to you for joining us. I want to begin with a few words about context. First, as all of you know, post-secondary education is currently facing multiple issues – educational, financial, and political. Mathematics is unique in its position, both as a subject in itself, and especially as a necessary part of students' preparation for other subjects and for their careers. Second, we at TPSE are not pioneers. Other fields, including biology and physics, have already gone through this. And throughout the math community, local innovations and experiments are underway. At TPSE our purpose is to learn from, network with, and accelerate the work of those innovators, and help scale it up. This is very much a movement that is already happening, and our desire is to accelerate and support it.
- Now let me turn to the urgency of what we are doing. The reason for the pioneering efforts I just mentioned is that the mathematics taught at the undergraduate level is commonly considered more of a barrier than a gateway to intellectual growth, degree completion, and rewarding careers. For example:
 - Of the students in the nation's 1,200 community colleges in 2012, 60% were assigned to remedial sections, for which they receive no credit. 80% of these remedial students failed either that course or a subsequent regular math course.
 - At the university level, student success in math is also low. 40% who begin engineering and 60% who begin computer science drop out or switch to another field.
 - Strict requirements of algebra or calculus are linked with poor college completion rates, yet they represent a deeply rooted tradition.
- While these situations have generally not improved over the decades, the uses and demands for mathematics are expanding throughout society – not only into the life sciences and engineering, but also the social sciences, entertainment, finance, and humanities.
 - Major universities face soaring demand for updated, more relevant math content using existing resources.
- The challenge before the mathematics community is to equip all college students with stronger quantitative knowledge and skills, AND to ensure that our nation has the talented workforce it needs in the competitive global economy.

2: Opportunities for Change

- What students want and need from mathematics education is a choice of pathways that offer opportunities for intellectual stimulation and rewarding careers.
- Early efforts at reform have shown that it is possible to lower barriers and widen pathways. Promising experiments have been generated by individual faculty, departments, institutions, and even whole states. For example:

- The New Mathways Project supported by Carnegie at UT-Austin has developed both a consulting network for more than 20 states and a choice of three pathways for community college students, with excellent results.
- Similarly, the state of Tennessee has found that the use of regular for-credit math classes accompanied by extra help (tutoring, lab, active learning) increases the pass rate by approximately fourfold among all student groups.
- Such early success can allow students to see the relevance of mathematics to their other courses and to the possibility of attractive careers.

3: Formation of TPSE

- TPSE's formation was a response to major changes in the field of mathematics itself, demands on the field from STEM and non-STEM departments, economic pressures, and technological and pedagogical changes throughout higher education.
- Additional impetus came from two influential reports: the National Research Council's *Math 2025*, which called for mathematics teaching that better aligns with other disciplines; and the President's Council of Advisors on Science and Technology's *Engage to Excel*, which reported widespread dissatisfaction in how undergraduate mathematics is taught to students outside the mathematics major. Both suggested that outdated course materials and teaching techniques have not provided students with the quantitative skills required for employment and good citizenship.
- These challenges led to a gathering here at CCNY in 2013, and this meeting prompted the formation of TPSE, which received initial funding from CCNY and Alfred P. Sloan Foundation.

4: A Role for TPSE

- Why shouldn't the math community just let early experiments move ahead on their own? What is the need for TPSE?
- It is true that the math community is rich in leadership and imagination, and many colleagues are well aware of the challenges I have touched on. But there are several difficulties. One is the highly decentralized structure and individualized culture of the mathematics community.
 - Compared with other STEM fields, such as physics, chemistry, and biology, we have far more (17!) professional organizations.
 - Each tends to focus on a particular sector of post-secondary education, such as advanced research in R1 universities, general education in four-year colleges, teacher preparation, industrial mathematics, statistics, community colleges, and so on.
 - The professional organizations focus on a particular sector and lack the tradition of collaborating on issues that span the mathematical sciences, especially those that require partnerships with other STEM fields.
- Therefore, TPSE, rather than advocating for a particular view or sector, has adopted the role of "honest broker" among the professional organizations, promoting and linking successful efforts. We seek to help the math community respond with coherence without increasing uniformity.

5: The Goals of TPSE

- Based on major reports and our own regional meetings, TPSE had driven home the need for transforming what and how we teach at the undergraduate level. This is an enormous challenge, because it requires math departments to change their role from gatekeepers to gateways for student success in college and beyond. It will necessitate change in both the structure and culture of the math community.
- To increase TPSE's "reach," diversity, and networking ability, we recently formed a Mathematics Advisory Group, or MAG, consisting mostly of math department chairs – those who work at the nexus of students, faculty, and administrations. In partnership with this group we hope to design RFPs for funding that makes it possible to scale up promising projects to regional and even national scale – the kinds of transformations that will be needed if we are to reform the ways mathematics is used and understood in today's data-rich world.
- We certainly do not to minimize the challenging nature of mathematics – as one member of TPSE has put it, math is "a grand edifice built over millennia." But math is becoming more important to society, not less. The solution is not to bypass math because it is a barrier but to enhance it because it is a gateway. Our own path is to make post-secondary mathematics education better, not harder, and to improve the education and career prospects of our students.

6: Strategic Planning

- As we move along that path, we have been helped considerably by the consulting firm Parthenon EY. After interviewing all of the TPSE members and dozens of key stakeholders, from a wide spectrum of perspectives, Parthenon generated a strategic plan last year that has been central to TPSE's activities, such as creation of a Mathematics Advisory Group consisting of mathematics department chairs. In addition, most of our current action priorities have grown out of Parthenon's careful work. Each action priority was chosen because innovative faculty or institutions had already begun the job. As I said at the outset, our strategy, like Parthenon's, has been to listen carefully to the math community, identify areas with the most momentum, and find ways to accelerate and coordinate that momentum.

Brit Kirwan will now introduce those priorities, and the TPSE members who will describe them.