

# **TPSEMath**

## **Chairs + 1 Conference**

### **Leading Change**

Moderator: Jim Lewis, University of Nebraska-Lincoln

Panelists:

Matt Ando, University of Illinois at Urbana-Champaign

Loek Helminck, North Carolina State University (and Hawaii)

Suzanne Weekes, Worcester Polytechnic Institute

# The call for change is not new

- At the **1993** Joint Meetings, Britt Kirwan said:

The AMS Task Force on Excellence must deal substantively with the issue of the quality of undergraduate mathematics education for all students, not just mathematics majors. The general population, who in the final analysis is our source of financial support, is demanding that this happen, and many of our most respected academic leaders concur.

# ***1999 – Towards Excellence***

*Towards Excellence*, was written by the AMS Task Force on Excellence. The opening line is:

- We have a simple message: To ensure their institution's commitment to excellence in mathematics research, doctoral departments must pursue excellence in their instructional programs.

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# **2003 – Applying the Science of Learning to the University and Beyond**

It would be difficult to design an educational model that is more at odds with the findings of current research about human cognition than the one being used today at most colleges and universities.

*Change, July/August 2003*

# 2009 – AMS Task Force on First-Year Mathematics

**Recommendations:** “First things first.”

- **Leadership matters**—success in this area depends upon the value assigned to it by a department’s leadership;
- Harness the power of technology to improve teaching and learning;
- Invest in teaching graduate students to be good teachers.

*AMS Notices, June/July 2009*

## ***2012 – Engage to Excel***

- Low-performing students with a high interest and aptitude in STEM careers often have difficulty with the math required in introductory STEM courses.
- A promising strategy to be explored?
  - “college mathematics teaching and curricula developed and taught by faculty from mathematics intensive disciplines other than mathematics ...”

# **2013 – 5-Year Strategic Plan of the President’s Committee on STEM Education**

The plan sets forth four strategic objectives to contribute to the goal of producing one million more STEM graduates in the next 10 years. One mentions mathematics (negatively):

- Address the problem of excessively high failure rates in introductory mathematics courses at the undergraduate level to open pathways to more advanced STEM courses.

# 2014 – Potential of Active Learning Strategies

Freeman et al. (2014). *Proceedings of the National Academy of Sciences*:

- “Active learning increases student performance in science, engineering, and mathematics.”
- Increases in examination performance would raise average grades by a half a letter.
- Failure rates under traditional lecturing are 55% higher than the rates observed under active learning.



# **Change, even dramatic change, is possible**

I became chair in 1988. I set one major goal that guided my work for 15 years:

Become a model for a department of mathematics in a research university where educational goals are integral to the departmental mission and are supported by broadly based participation in educational programs.

This work has continued under the outstanding chairs that followed me.

# In the 1980s, only 23 PhDs – none to women

## 2004: Has the women in math theorem been proved?

- Of the 36 departments averaging more than 7.5 Ph.D.s/yr, between 1995 and 2003, (47% of all math Ph.D.s.) only 4 awarded more than 26% to women.
- At the top of the list was Nebraska where 41% of their Ph.D.s to women.
- The department's Presidential Mentoring Award was for its success mentoring women graduate students in mathematics.

Today, the success continues

- The Nebraska Conference for Undergraduate Women in Mathematics attracts 250 women per year.
- Over the last 10 years, we have awarded 100 Ph.D.s with 45 awarded to women.

# A commitment to teaching

- Faculty tenure-track FTE: 31.15 (23% female)
  - 75% of the tenured (and recently retired) faculty have won a college or university teaching award.
  - In 1998, the department won a Nebraska system-wide teaching award.
  - In 1998 the department won an NSF Presidential Award for Mentoring
  - In 2009, the department won the AMS Exemplary Program Award
  - ~\$27 million in external funding since 2004 to support math teacher professional development

# **Transforming Instruction to Increase Student Success**

In 2012, our new chair, Judy Walker launched an initiative to improve student success in precalculus mathematics courses by emphasizing active learning.

We focused on two large “precalculus” courses that together enroll about 1000 students including 770 first-time freshmen. The courses are primarily taught by GTAs in their 1<sup>st</sup> or 2<sup>nd</sup> year of teaching their own class. Over the previous five years, success in these courses (i.e. earning a grade of C or better) was less than 64% in the fall (60% in the spring).

- We stumbled at first, but starting with Spring 2013, we began to see results. Judy convinced the university to:
  - Hire a Director of First-year Mathematics to oversee the program.
  - Renovate four classrooms for active learning.
  - Extend class time to 225 minutes for a 3-credit course and 300 minutes for a 5-credit course.
  - Give GTAs a 1-course teaching reduction the first time they taught in this program so that they had time to take a 3-cr course on learning to teach mathematics.
  - Hire undergraduate “learning assistants” to assist the GTA in each class.
- We selected a text to match our instructional philosophy, began using WeBWork to support homework, developed out of class “team quizzes,” invested heavily in developing lesson plans for each class day, and hired GTA “master teachers” to mentor their peers.
- The results are impressive. Student success for the last three fall semesters has been about 80%. And, we believe our students are learning more.

# My advice to department chairs

- Lead don't manage
- Meet an institutional need
- Work on Job 1
- Focus on your strengths;  
minimize your weaknesses
- Individualize faculty assignments
- Promote change gradually