TSPE-MAG Panel: Lessons from Postsecondary Reform in Other STEM Disciplines

Moderator: Susan Singer, NSF
Physics: Bob Hilborn, AAPT
Geosciences: Kim Kastens, Columbia University
Biology: John Jungck, University of Delaware
Engineering: Karl Smith, University of Minnesota
Approach

• Goals:
  – Share lessons learned about improving practice and role of discipline-based education research in other STEM field: physics, geosciences, biology, engineering
  – Encourage research and practice integration (rich history of RUME)

• Approach:
  – 10 minute overviews
  – Discussion

• Resources posted to TPSE website
Some Notes on the History of RUME

Compiled by Jack Bookman, Lloyd Douglas, Tim Fukawa-Connelly, Shandy Hauk, Eric Hsu, Karen Marrongelle, TJ Murphy, Chris Rasmussen, Annie Selden, Natasha Speer, Aaron Weinberg
25+ Years of RUME

1989-1991
- UME Trends
- JMM session on RUME
- RUMEC (+) Joint CMTE on RUME (until 2005)
- RCME Volume I
- RCME Volume II

early 90’s
- Formal conferences on RUME
- RCME Volume III
- Association for RUME

1996-1999
- RCME Volume IV
- RCME Volume V
- RCME Volume VI
- RCME Volume VII

2000-2010
- Making the Connection: Research and Teaching in Undergraduate Mathematics Education (MAA Notes Volume 73)

2000 → 2015
- SIGMAA on RUME
- International Journal of RUME (Springer)
Notes:
2001: September conference cancelled because of 9/11
2002: Pre-session to MAA MathFest instead of stand-alone conference
2004: No conference because shifting annual date (October 2003 to February 2005)
Note: The RUME Conference began a *Proceedings* in 2007.
Note: From a systematic but not exhaustive search in Academic Search Premier (ASP). 2014 is the most recent full year for which ASP promises complete data for a journal. Search terms "peer-reviewed" "mathematics" "undergraduate or college" resulted in about 1800 hits. A review of titles (and abstracts when needed) identified which were RUME. Selection criteria: research about undergraduates learning mathematics and/or college faculty teaching mathematics (e.g., some papers that appeared in JMTE are included because they are about pre-service teachers learning mathematics in college mathematics classes).
Lessons from Physics

• Long tradition of physics education research
  – PhysPort.org: user-friendly resources for interactive engagement teaching and assessment
• 1990s presented strong incentives for change
• 1999-2003 SPIN-UP –
  – Departments are the crucial units for change.
  – The PROGRAM is more than the courses.
  – Increasing # of majors ↔ improved “service” courses
  – Time scale for significant change is 5-10 years
• 1996-present: Physics and Astronomy New and Experienced Faculty Workshops – over 1800 alumni
  – Now reaching 50% of new tenure-track hires
  – TYC New Faculty Experience
• AAPT/APS Joint Task Force on Undergraduate Physics Programs – preparing students for diverse careers
• APS/AAPT Physics Teacher Education Coalition – engaging physics departments to meet the strong demand for highly qualified physics teachers
• All programs have enhancing diversity efforts
Suggestions from Geoscience Education Reform

- Build a community of practice of faculty who share a passion for improving education
- “…simple clear messages repeated often by a variety of trusted sources…” Edward Maibach on climate communication
- Build a library or portal of peer-recommended teaching resources
- Learn from social scientists and K-12 education researchers
- Reflect on what cognitive processes and intellectual approaches are characteristic of your discipline
- Learn more about what employers value
- Learn more about what critical incidents entrain, retain or repel students from your field, especially under-represented minorities
Supporting Sustainable Student Success in Biology
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Two Engineering Education Reform Examples

Cooperative Learning in Engineering Education and beyond 1974 - present

Engineering Education Research & Innovation 2004 - present

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Figure 2. Changes in Faculty Teaching Practices, 1989 to 2014
(% Marking “All” or “Most” Courses)
DBER PhD Programs (xER)

- Engr. Sci. Reform
- Curricula Reform

EC2000

- EER
- Geoscience
- Biology ER

- Curricula Reform

Chemistry ER

- Curricula Reform

Physics ER

Medical ER


DBER is located in the relevant disciplinary school, e.g. medicine, physics.
Reflection and Dialogue

• Individually reflect on your insights, take aways, questions, etc. from the panel so far. Write for about 1 minute.

• Turn to a neighbor, introduce yourself, and share your ideas, listen carefully to your neighbors ideas. Discuss with your neighbor for about 2 minutes
  – Select/create a response to present to the whole group if you are randomly selected