Transforming Institutions: 21st-Century Undergraduate STEM Education
Preconference Workshop 4

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Workshop Description:
Higher education is increasingly challenged to prepare students for life and work in the 21st-Century, particularly careers in STEM. While a substantial amount is known about course and curricular transformation, much less is known about how to bring about institutional change. Achieving sustainable institutional transformation around the widespread adoption of evidence-based teaching practices is not a simple process. Emerging models for institutional transformation utilize best practices from diverse fields. This workshop will summarize the current state of higher education STEM systemic reform efforts and engage the audience in suggesting next steps in the path toward institutional transformation.

Workshop Outline:
Introduction
    Reflection
Overview of Models of Institutional Change and Major Initiatives
    Participant Discussion and Sharing
Issues Related to Faculty and Faculty Development
    Participant Discussion and Sharing
Role of Assessment in STEM Education Reform
    Participant Discussion and Sharing
Thinking about Next Steps

Workshop Objectives:
At the completion of this workshop, participants will be able to:
*   identify models of institutional change and key initiatives related to undergraduate STEM education;
*   describe issues related to faculty and faculty development in institutional change initiatives;
*   discuss the role of assessment in STEM education reform efforts at both the classroom and institutional levels; and
*   develop personal action steps to take upon return to your institution.

Key Resource:
Weaver, G. C., Burgess, W. D., Childress, A. L., & Slakey, L. (Eds.) (2016). *Transforming institutions: Undergraduate STEM education in the 21st century*. West Lafayette, IN: Purdue University Press.
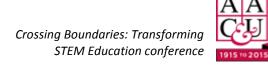
Reflection to Establish a Personal Context for this Workshop

What is your personal goal regarding institutional transformation around undergraduate STEM education and where do you intend for this to happen? State in 3 sentences or less.

Overview of Models of Institutional Change and Major Initiatives

Discussion Questions:
- What elements of existing reform initiatives might be applicable to your situation?
- How could these models and theories contribute to you reaching your institutional transformation goal?

Notes:

Issues Related to Faculty and Faculty Development

Discussion Questions:
- How can development and support of faculty help you in achieving your institutional transformation goal?
- What challenges will you need to address in establishing faculty development efforts toward this goal (consider things that are already well addressed in your context versus those that are not yet – e.g. disciplinary differences, departmental/unit readiness, communication on campus, etc.)?

Notes:

Role of Assessment in STEM Education Reform

Discussion Questions:
- What types of data would help support you in your institutional transformation goal?
- What will you need to consider with respect to implementing assessment efforts to gather these data?

Notes:

Next Steps

Activity:
Write down 2-3 immediate actions to take upon returning to your campus. Consider something you will do on your *first day* back, something you will do in the first month, and something you will do within the first three months. (Be prepared to report out.)

Notes:

Resources Related to Models of Institutional Change and Major Initiatives:

Frameworks and networks
APLU STEM Initiatives
- http://www.aplu.org/projects-and-initiatives/stem-education/science-and-mathematics-teaching-imperative/
- http://www.aplu.org/projects-and-initiatives/stem-education/SMTI_Library/TEPA/file
- https://serc.carleton.edu/StemEdCenters/index.html

AAU STEM Initiative
- https://stemedhub.org/groups/aau
- https://stemedhub.org/groups/aau/File:AAU_Framework_030114.pdf

Keck/PKAL Initiative - https://www.aacu.org/peerreview/2015/spring
The Bay View Alliance - http://bayviewalliance.org/
PULSE community - http://www.pulsecommunity.org/ ;click on their resources pages
Networked Improvement Communities
- http://www.carnegiefoundation.org/resources/publications/getting-ideas-action-building-networked-improvement-communities-education/
- http://www.carnegiefoundation.org/

Disciplinary Society networked initiatives
- ISSUES - http://serc.carleton.edu/issues/index.html
- Common Visions in Mathematics - http://www.maa.org/programs/faculty-and-departments/common-vision

Tools
The following web sites serve the community working on organizational level change in STEM education. They each arose from other purposes and now are reaching toward the Transforming Institutions community. We are working to assure synergy among them. Be alert for changes in this picture.
- STEMEdHub - https://stemedhub.org/
- SERC - http://serc.carleton.edu/serc/about/index.html
- STEMCentral - https://stem-central.net/

Resources Related to Faculty and Faculty Development:

- A useful framework for designing courses, curricula and program from a learning-centered viewpoint: *Understanding by Design*, Grant Wiggins and Jay McTighe.
- A group of faculty at Carnegie Mellon University produced a guide to pedagogy based on cognitive science. This is a practical guide developed by a faculty learning community. See S. Ambrose, M. Bridges, M. DiPietro, M. Lovett, M. Norman. *How Learning Works: Seven Research-Based Principles for Smart Teaching,* San Francisco, CA: John Wiley & Sons (2010).
- Lessons learned from cognitive science and tested in the HHMI/NAS Summer Institutes are summarized in J. Handelsman, S. Miller, and C. Pfund , *Scientific Teaching* W.H. Freeman 2006.
- *Reaching Students,* Nancy Kober, Washington, DC: National Academies Press (2015).
- For a faculty member or department just getting into conversion of lecture based courses to more student-centered pedagogy, see especially the beginner's guide from the Carl Wieman Science Education Initiative (CWSEI). This is a very useful brief compendium of practical advice. http://www.cwsei.ubc.ca/resources/files/CourseTransformationGuide_CWSEI_CU-SEI.pdf.

- *Learner-centered Teaching: Putting the Research on Learning Into Practice*, Terry Doyle, Sterling, VA: Stylus (2011).
- *Teaching at its Best*, Linda B. Nilson, San Francisco, CA: Jossey-Bass (2010).
- CWSEI maintains a webpage listing a number of additional resources for course transformation. See http://www.cwsei.ubc.ca/resources/index.html

Resources Related to Assessment in STEM Education Reform:

AAC&U LEAP and VALUE Initiatives
- https://www.aacu.org/leap
- https://www.aacu.org/value
- https://www.aacu.org/value-rubrics

Selected Assessment Information/Instruments:
- Measuring STEM Teaching Practices Report http://ccliconference.org/files/2013/11/Measuring-STEM-Teaching-Practices.pdf
- Learning Climate Questionnaire (Black & Deci, 2000; Williams & Deci, 1996) http://www.learningandthinking.co.uk/Learning%20Climate%20Questionnaire.pdf
- Basic Psychological Needs Scale http://www.selfdeterminationtheory.org/basic-psychological-needs-scale/
- Classroom Experience Questionnaire (CEQ) https://www.washington.edu/oea/pdfs/reports/OEAReport0709.pdf
- Student Assessment of their Learning Gains (SALG) (Seymour, 1997) http://www.salgsite.org/
- Teaching Practices Inventory (Wieman & Gilbert, 2014) http://www.cwsei.ubc.ca/resources/TeachingPracticesInventory.htm
- Teaching Dimensions Observation Protocol http://tdop.wceruw.org/
- Western Michigan WIDER Instruments https://app.box.com/s/5xbsr88ji7vmzn9aj006
- Classroom Observation Protocol for Undergraduate STEM (COPUS) (Smith, Jones, Gilbert, & Wieman, 2013) http://www.cwsei.ubc.ca/resources/COPUS.htm
- PULSE Community Vision and Change Certification and Rubric http://www.pulsecommunity.org/page/v-c-certification
- National Survey of Student Engagement (NSSE) http://nsse.indiana.edu/
- Student Experience in the Research University (SERU) survey http://www.seru.umn.edu/
- Gallup Purdue Index https://www.luminafoundation.org/files/resources/galluppurdueindex-report-2014.pdf