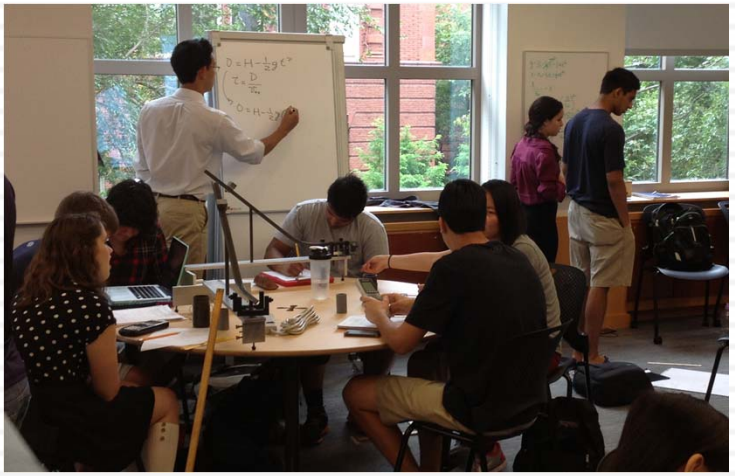
AAU Undergraduate STEM Education Initiative

Measuring Progress



Emily Miller and Josh Trapani
Association of American Universities (AAU)
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Presentation Outline

- Background on AAU and the Undergraduate STEM Education Initiative
- Project Site Evaluation: Tools and Findings
- Measuring Progress report

Background

A higher education association whose members are public and private research universities.

Federal advocacy around issues important to research-intensive universities, such as:

--funding for research
--research policy issues
--undergraduate and graduate education.

AAU also regularly convenes groups of senior campus administrations to discuss issues of concern.

AAU Undergraduate STEM Education Initiative

Launched in 2011.

Overall objective: encourage and support use of teaching practices proven to be effective in engaging students and helping them learn.

Main components:

- Framework
- Project Sites & Network
- Institutional & Federal Policies

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RESEARCH CORPORATION for SCIENCE ADVANCEMENT
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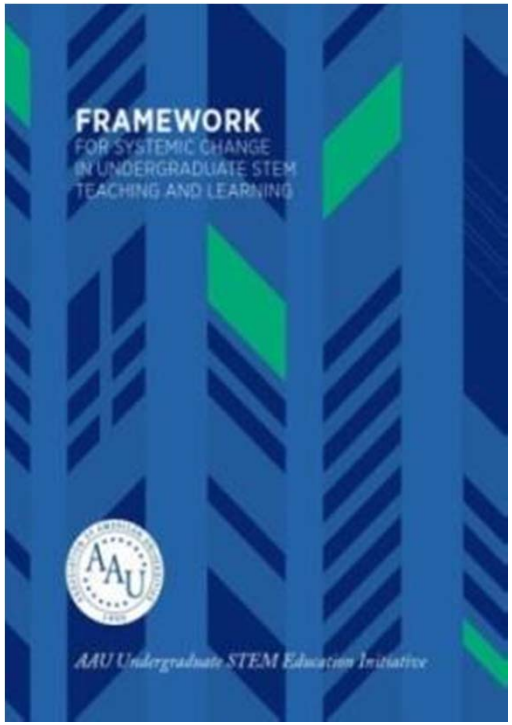
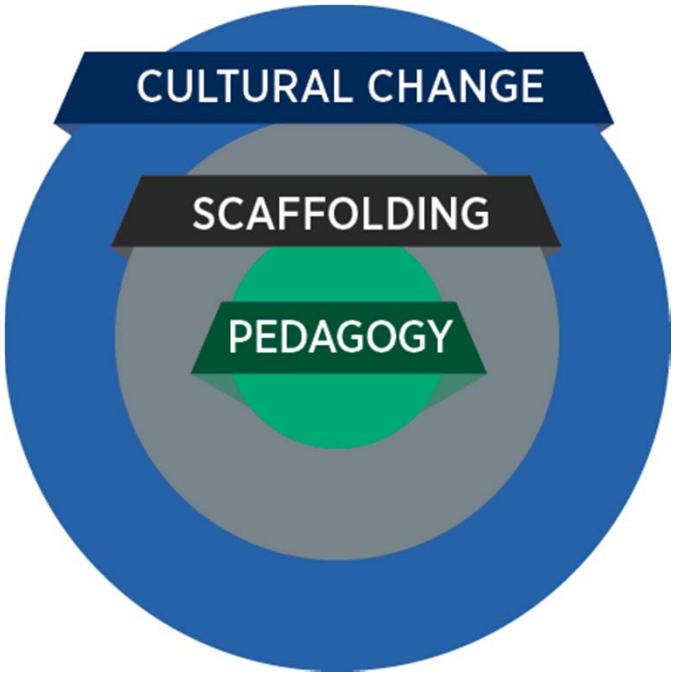
Framework for Systemic Change in Undergraduate STEM Teaching & Learning





Provides a set of key institutional elements that need to be addressed in order to bring about sustainable change.

Key Institutional Elements

Pedagogical Practices	Scaffolding	Cultural Change
▪ Articulated Learning Goals ▪ Educational Practices ▪ Assessment ▪ Access	▪ Provide Faculty Professional Development ▪ Provide Faculty with Accessible Resources ▪ Collect Data on Program Performance ▪ Align Future Facilities Planning	▪ Leadership Commitment ▪ Establish Strong Measures of Teaching Excellence ▪ Align Incentives with the Expectation of Teaching Excellence

Available online at: https://stemedhub.org/groups/aau/aau_resources

AAU STEM Project Sites

Project Site Evaluation

Project Site Evaluation

- Campus Site Visits
- Annual Reports
- Common Data from Project Sites

NSF "Widening Implementation & Demonstration of Evidence-Based Reforms" (WIDER) grant

Project Site Common Data

- Metrics components
  - Instructor Survey
  - Campus Infrastructure
  - Evaluation of Teaching
- Administered in 2014 to develop baseline
- Will be administered again in late 2016
- Non project site campuses could also use
- Overall project site “impact”

Instructor Survey

- Overall
  - 2,971 received the survey across eight project sites, and 1,093 responded (36.8%).
  - Individual campus response rates varied from about 22% to about 70%.
  - Meaningful variation existed in responses (e.g., mean on behavioral statements was 2.76 on a 4-point scale).

- Cleaning/standardization of response data:
  - Respondents binned into categories (e.g., tenured faculty, instructors, etc.)
  - Departments binned into disciplinary categories
  - Classes binned into levels

Instructor Survey

- Overall respondent demographics
  - **By rank/role:**
    - 50% faculty with tenure
    - 12% tenure-track faculty
    - 26% graduate students
    - 12% all other (non-TT faculty, instructors, lecturers, etc.)
  - **By discipline:**
    - 27% physics
    - 19% biology (12% molecular/cellular, 7% organismal/general)
    - 17% engineering
    - 16% chemistry
    - 12% psychology, behavior, physiology
    - 6% mathematics
    - 3% no response

Instructor Survey

- Overall respondent demographics
  - **By course level** **("lowest level, highest enrollment course taught within past year"):**
    - 46% lower division
    - 10% mid-level
    - 13% advanced/graduate level
    - 32% couldn't be categorized (includes cases where instructor hadn't taught in past year)

Instructor Survey

- High-level findings across project sites:
  - Attitudes and beliefs out of sync with behaviors and practices (overall means 3.37 vs. 2.76).
  - Perceptions of recognition of importance of teaching by departmental and campus administrators (>3.0) out of sync with perceptions of the role effective teaching plays in annual review and salary (≈2.5).
  - Most felt quality of evidence for teaching used was of low (about 33%) or medium (about 50%). Only about 15% judged the quality high.

Instructor Survey

- More high-level findings across project sites:
  - Respondents tended to favor "local" centers or units focused on teaching and learning.
  - Respondents were eager for interaction as part of professional development: teaching development events, peer evaluations, availability of mentors on-campus, and off-campus mentors and cohorts of scholars all rated highly.
  - Instructors generally agreed (mean = 2.9) that they perceived that others in their department believed that ongoing improvement in teaching was part of their jobs.

Campus Infrastructure

- Used part of the PULSE Vision & Change rubric.
- When each department submitted a separate response, we averaged this to arrive at a single institutional figure.

Campus Infrastructure

- Findings:
  - Aggregate responses ranged from 2.5 to 3.9 on a 0.0 to 4.0 scale. However, out of 10 items, 6 scored below 3.0 overall.
  - Lowest scores were in:
    - Access to flexible, re-configurable teaching spaces (2.5)
    - Informal gathering spaces (2.5)
    - Staff support for teaching (2.6)
  - Highest scores were in:
    - Classrooms and labs that accommodate special needs (3.7)
    - Institutional support for electronic resources (3.9)

Evaluation of Teaching

- High-level findings across project sites:
  - 32 project site departments submitted statements
  - The department statements on the evaluation of teaching had much in common across departments and institutions
    - strong assertions that teaching is highly valued
    - all departments make use of student evaluations at the end of courses
    - annual award for excellence in teaching
  - From many of the statements (19 of 32, or 59% of those submitted), it would be impossible to discern whether attention to student-, active-, or evidence-based pedagogy was either recognized or required.

Evaluation of Teaching

- To help achieve the hoped-for larger effect, we believe that greater emphasis in faculty evaluation policies and practices should be placed on the use of evidence-based student-centered methods as an expectation for instruction in promotion and tenure/annual reviews.

Project Site Impact

- Number of academic years: 2
- Number of universities: 8
- Number of departments: 37
- Number of courses: 129
- Total Student Participation in Transformed Courses: 82,938

	Teachers					Assistants				Students
	# Faculty - Tenured	# Faculty - Tenure-track	# Faculty - Not Tenure-track	# Instructors	Total	# Grad	# UG	Other	Total	Total
Year 1	48	9	19	31	107	479	261	14	745	37,959
Year 2	89	22	43	36	190	649	278	4	931	44,979

Measuring Progress

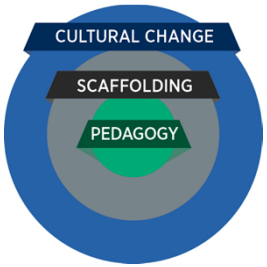
Goals

- Provide a comprehensive & customizable way to measure progress along the set of key institutional elements identified in the Framework
- Serve as a useful tool for continuous improvement of undergraduate STEM education
- Identify and articulate cross-cutting issues in a way that we hope also has the potential to help facilitate discussions across campuses

Process

- Draft spreadsheet and report informed by numerous sources and discussions
- Currently out for review by all AAU member campuses: deadline for feedback is late April
- We will provide the final report to the committee

Structure



PEDAGOGY

ARTICULATED LEARNING GOALS

- Develop shared learning goals and outcome measures
- Consider learning at all levels, from individual courses through programs and degrees
- Make learning goals explicit to the students and connect assignments to learning goals throughout the course

ASSESSMENTS

- Develop and utilize instructor-independent tools to assess student learning
- Teach for, and measure, long-term retention
- Use assessment instruments (and research on assessments) for commonly-cited outcomes that are hard to assess, like "scientific" thinking or problem solving skills

EDUCATIONAL PRACTICES

- Engage students as active participants in learning
- Implement teaching practices proven by research to be effective in STEM education (e.g. evidence-based teaching, scientific teaching)[3]
- Use data on student learning to refine practice
- Use scenarios and real-world examples
- Use technologies effectively

ACCESS

- Ensure that STEM courses are inclusive of all students
- Implement practices known to enhance students' self-efficacy

3 Handelsman, J., Ebert-May, D., Beichner, R., Bruns, P., Chang, A., DeHaan, R., Gentile, J., Lauffer, S., Stewart, J., Tilghman, S.M., and Wood, W.B. (2004). Policy forum: scientific teaching. Science 304, 521-522. Available at www.hhmi.org/science_ed/pa_pp521_521.pdf

Key Questions

Data Sources and Analytical Tools

Institutional Levels

Examples

Measuring Progress toward Systemic Change in Undergraduate STEM Teaching and Learning							
AAU Framework: First-Order Heading	AAU Framework: Second-Order Heading	AAU Framework: Third-Order Heading	Question (Taken from past iterations of baseline measures, framework, and PCAST report)	Potential Tool	Appropriate for Departments?	Appropriate for Schools/ Colleges?	Appropriate for Institutions?
Pedagogy	Educational Practices	Engage students as active participants in learning	How much time is being spent on various kinds of activities in the classroom?	Classroom Observation Protocal for Undergraduate STEM (COPUS), Reformed Teaching Observation Protocol (RTOP) , Observing Patterns of Adaptive Learning (OPAL), Generalized Observation & Reflection Platform (GORP)	X	X	X
Scaffolding	Provide faculty professional development	Develop faculty awareness of the research bases and underpinnings of approaches	What opportunities for professional development related to instruction are open to faculty (both on-campus and off-campus through disciplinary societies and other national organizations), and to what extent are they taking advantage of these opportunities?	Partnership for Undergraduate Life Science (PULSE) Rubric, Participation in National Academies Summer Institute or NSF's Faculty Institutes for Reforming Science Teaching (FIRST).	X	X	X

Selected Questions (currently 56 total)

Pedagogy

- How many courses have developed learning goals? For how many programs do these individual course learning goals connect to learning goals at the program, major, or departmental level?
- Are learning goals/objectives clearly noted in syllabus?
- Are students exposed to the diversity of possible STEM careers?
- How do retention and success vary by demographic categories? What effects do particular interventions have on these gaps?

Selected Questions (currently 56 total)

Scaffolding

- What is the current level of awareness and knowledge among faculty of evidence-based teaching methods?

- What type of instructional staff and faculty teach STEM courses, and at which level? Do they have access to appropriate support in learning and using appropriate pedagogies?

- What departmental and campus resources exist to support faculty in efforts to improve their instruction, and to what extent are faculty utilizing these resources?

Selected Questions (currently 56 total)

Cultural Change

- Are there meaningful awards for good teaching at the departmental, school/college, and institutional level? Are they based on use of evidence-based pedagogy?

- What role does teaching play in promotion and tenure decisions in the relevant departments or schools at the university?

- Are the president's and provost's support of evidence-based pedagogy obvious to instructors, students, and the public? How do budget allocations reflect this as a priority?

Recommendations

- Explore new ways to link data sets to support timely decision-making that benefits the institution while protecting privacy
- Develop common data definitions, standards, formats, and methodologies to the extent possible
- Differentiate types of research and evaluation
- Address IRB and FERPA
- Institutions should lead on developing and sharing information

Discussion & Questions

Dissemination

- Achieving Systemic Change: A Sourcebook for Advancing and Funding Undergraduate STEM Education. Washington, D.C.: Association of American Colleges and Universities. www.aacu.org/CRUSE
- Weaver, G.C., Burgess, W. D., Childress, A.L., Slakey, L (Eds.), Transforming Institutions: Undergraduate STEM education for the 21st century. West Lafayette, IN: Purdue University Press. http://www.thepress.purdue.edu/titles/format/9781557537249
- *Not Just Research: Organization of leading universities is pushing for undergraduate STEM education to get more attention -- and initiative seems to be yielding results.* https://www.insidehighered.com/news/2015/08/20/aaus-push-science-teaching-yielding-results.
- *Improve undergraduate science education* *http://www.nature.com/polopoly_fs/1.17954!/menu/main/topColumns/topLeftColumn/pdf/523282a.pdf*
- *Colleges Reinvent Classes to Keep More Students in Science* http://www.nytimes.com/2014/12/27/us/college-science-classes-failure-rates-soar-go-back-to-drawing-board.html
- *A National Organization Leverages Systemic Change in STEM Teaching and Learning* https://stemedhub.org/groups/aau/File:Reaching_Students_DBER_Practioner_Guide.pdf