Designing Comprehensive Undergraduate STEM Reform

SoCal PKAL Network Meeting
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Presenters:
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Also present: Christine Broussard, University of La Verne; Sue Lowery, University of San Diego

Session Outcomes

- Learn about the Keck/PKAL research-based STEM Education Framework project
- Better understand the elements required for comprehensive undergraduate STEM reform
- Understand the benefits and challenges involved in mounting institution-wide STEM reform initiatives
- Gain practical knowledge about implementation of framework elements from project leaders
- Apply framework elements to your campus
Keck/PKAL Framework Project

This initiative will develop a comprehensive, institutional STEM Education Effectiveness Framework that will help campus leaders translate national recommendations and research for improving student learning and success in STEM into scalable and sustainable actions on particular campuses:

A Scientific Framework for Strategic Change in STEM Education

VISION AND CHANGE
A CALL TO ACTION

A SUMMARY OF RECOMMENDATIONS
BASED ON A NATIONAL CONSENSUS DEVELOPED UNDER THE GUIDANCE OF AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

WITH SUPPORT FROM THE NATIONAL SCIENCE FOUNDATION
Division of Undergraduate Education
and Office of Education and Human Resources

and the Division of Graduate Education and Human Resources

Directional to Strategic Initiatives

July 15-19, 2009
Washington, D.C.

www.visionandchange.org
From the Report: Recommendations

1. Integrate Core Concepts and Competencies throughout the Curriculum
   - E.g., Define learning goals so that they focus on teaching students the core concepts, and align assessments so that they assess the students’ understanding of these concepts.

2. Focus on Student-Centered Learning
   - E.g., View the assessment of course success as similar to scientific research, centered on the students involved, and apply the assessment data to improve and enhance the learning environment.

3. Promote a Campus-wide Commitment to Change
   - E.g., Advocate for increased status, recognition, and rewards for innovation in teaching, student success, and other educational outcomes.

Engage to Excel: One Million Additional College Graduates with Degrees in STEM (PCAST Report)

- Widespread adoption of empirically validated teaching practices.
- Replace standard laboratory courses with discovery-based research courses.
- National experiment in postsecondary mathematics education.
- Diversity pathways to STEM careers.
Engage to Excel: One Million Additional College Graduates with Degrees in STEM (PCAST Report)

- From 300,000 annually to 400,000 (~33% increase)
- Increased demand for “STEM-capable” workforce (e.g., health care, manufacturing)
- Focus on creating more engaging, intentional & supportive learning environments

DBER Report

- Defines DBER – Discipline-Based Education Research – as a recognized scholarly endeavor
- Synthesizes findings from DBER research studies on teaching, learning, assessment, etc.
- Makes recommendations for improving the use (translation) of DBER findings into practice
- Makes recommendations for advancing DBER as a field
Participating Campuses

PI: Susan Elrod; Evaluator: Adrianna Kezar

What a Framework Helps Accomplish

- Articulates a **vision** or direction for change
- Audits or **evaluates** where you are now and where you want to go
- Charts a **path** for reaching the vision and goals
- Creates a **common language** and vision around the change
- Pinpoints needed **interventions** and strategies
- Fosters **learning**
- Serves as **accountability** tool for maintaining momentum on the change
- Serves as **catalyst** for priority setting
- Ensures **collective leadership**
- Justifies **resources** (financial and human) for the vision
- Maintains **focus and momentum** over the long time period change often takes
What is your vision for STEM education on your campus?

INITIAL Framework Elements

Campus Teams:
Faculty
Institutional Leaders
Office of Institutional Research

Vision
Align w/ Institutional Priorities
Landscape Analysis
Identify & Analyze Challenges
Choose Strategies
Implement
Measure & Disseminate Results
Keck/PKAL STEM Education Framework v 2.4

Informed by research, reports and experience of project teams

Keck/PKAL Framework – An Example

W.M. Keck Science Department
Claremont McKenna College • Pitzer College • Scripps College

The Claremont Colleges
5 independent, undergraduate institutions
5 Presidents
5 Boards of Trustees
• Claremont McKenna
• Pitzer
• Scripps
• Pomona
• Harvey Mudd

Also 2 graduate institutions
• Keck Graduate Institute
• Claremont Graduate University
Keck/PKAL Framework – An Example

**Campus Vision:**
- Aim to provide the best outcome for every student admitted
- Recognize students may come from very different socioeconomic environments
- Assume students will rise to clearly articulated, high expectations when given proper support

**Framework Team:**
- David E. Hansen, Dean and Professor of Chemistry
- Mary Hatcher-Skeers, Professor of Chemistry
- Bidushi Bhattacharya, Director of Sponsored Research and astronomer

Who are the Stakeholders?
- Students - Retention study of 5363 science students, 2005-2011
  - Math SAT correlates with performance in Introductory Chemistry but not Introductory Biology
  - Underrepresented STEM groups earn lower grades in intro bio/chem
  - Comparable numbers of students of all backgrounds major in science

**Other Stakeholders:**
- Faculty – get buy in
- Institutional Leadership – (5C) HHMI proposal !!!
- External groups – prospective students, Boards of Trustees, donors – 3C
Keck/PKAL Framework – An Example

Can We Begin?
• HHMI dataset
  • Student need
• HHMI proposal and award
  • Institutional buy-in
  • Keep administration engaged
• KS Dean meets monthly with 3C Presidents
• Resources
• Faculty interest

Media Teams:
• Actively marketing department for 2 years

Keck/PKAL Framework – An Example

Summer Science Immersion Program:
• Pilot Program
• Pre-college, one-week program
• HHMI funded (5C buy in!)
• Instructors included faculty, staff
• Hands-on labs in chemistry, biology, astronomy field trips
• Retention beyond pre-med goals

Media Outreach:
• Departmental website feature, including interviews of students from CMC, Pitzer, and Scripps
• Offered during program to 3C Media Offices
• Departmental video
• Distributed to 3C's
Keck/PKAL Framework – An Example

**SSIP:**
- Invited all incoming students to apply
- ~250 possible science majors; max 60
- accepted all 38 applicants

**Framework:**
- Effective tool for clarifying methods, goals
- Useful for revisiting our plan

**Results:**
- Compare to HHMI study in 4 years
- Student feedback positive

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**Getting Started**

**Determine Team Composition**
- Individuals with systemwide responsibilities
- Individuals who have a connection or working on STEM

**Bringing Team Together**
- Conference call to provide an overview of the PKAL-Keck Project and introductions
- Select which team members would attend first meeting

**Assumptions**
- Interested or saw need for STEM education reform
- Believed that they were responsible for addressing the need
- Everyone came to the table feeling empowered
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Vision

What We Did

- A draft vision was developed by 2-3 team members (of 6 members)
- Draft vision shared with team during monthly call
- Team could not agree on the draft vision because of initial assumptions

What We Discovered

- We weren’t ready to act:
  - Team building takes time (1 year!)
  - Differing viewpoints on the necessity for a team leader
  - Lack of institutional buy-in at the system level
  - Need feedback from campuses about their vision for STEM
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**How We Moved Forward**

- Held 1-day team retreat
- Hired an external facilitator
- Invited 2 system executives
- Shared campus feedback with team
- Individuals shared their personal perspective on STEM through facilitated SWOT analysis (this was our landscape and analysis process)

**Outcomes**

- Crafted a shared vision
- Developed agreed upon goals
- Recognition that competing demands would impact team effectiveness
- Garnered systemwide buy-in
- Discovered lack of internal financial support
- Determined our measurement process

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**What We Did**

- Establish the collaborative leadership model
- Held recurring team meetings (every 6 weeks)
- Collaboratively crafted a series of grant proposals as a team (4)
- Gathered data
- Shared individual projects and proposals with team to strategically coordinate efforts to bolster shared vision
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### What We Did

- Developed measurements for each goal. *(example below)*
- **Goal:** Encourage campuses to support & reward implementation of effective HIPs
- **Measure:** Establish mini-grant program to affect curriculum reform

### What Has Resulted

- Team members are communicating the vision and implementing programs and strategies
- Ability to quickly respond to external grant opportunities
- Influenced the right strategic vision for the CSU, including HIPs, data collection, and evidence based decisions

### Next Steps

- Roll out funded grant initiatives
- Host systemwide faculty development institute
- Support the CSU’s Data Dashboard
- Continue collaborative leadership meetings
- Determine other work including, building momentum for effective STEM education and disseminating results of our grant programs and collaborative leadership model
ACTION: Small group discussions

- What is your campus climate for change?
  - Other change processes, administrative support, resources,

- Where are you in the process? Where in the Framework do you think you might start?

- Who might be on the initial change team?

- How do you think the process will unfold on your campus? Where do you think you might encounter challenges?

- Draw a map for change!