A Project Kaleidoscope at AAC&U Project

Funded by
the W.M. Keck Foundation
An invitation
to Southern California Institutions

You are invited to join the Southern California (SoCAL) PKAL Regional Network.

The SoCal PKAL network is one of the many Project Kaleidoscope networks across the country. You can read more about these networks on the PKAL website at: http://www.aacu.org/pkal/regionalnetworks/index.cfm.

The SoCAL Network includes scientists from the Claremont Colleges, University of La Verne, CSUF, CSULA, University of Redlands, Whittier College, CSULB and growing. Please become part of our group and help us collaborate to improve science education across our region!

To learn more visit the SoCAL website at: http://www.astro.pomona.edu/pkal/
SUMMARY AGENDA

Thursday, April 26, 2012 - Fullerton Marriott

5:00 p.m.  WELCOME RECEPTION  Courtyard
           Project Overview & Goals

6:00 p.m.  DINNER & PANEL  Salon AB
           National Perspectives on Benchmarking STEM Student Success

7:30 p.m.  PLENARY ACTIVITY  Salon AB
           What is Our Vision for Undergraduate STEM Student Success?

Friday, April 27, 2012 - California State University, Fullerton

Note: Parking Information and Campus Maps are on pages 157-158
      All CSU sessions in Titan Student Union
      Please check-out of hotel prior to meeting

8:00 a.m.  BREAKFAST  Ontiveros ABC

8:30 a.m.  PLENARY PRESENTATION  Ontiveros ABC
           Goals for the Day & Presentation of Framework Models

9:30 a.m.  SMALL GROUP DISCUSSION I  Listed on Pg. 20
           Discussion of Framework Models

10:30 a.m. SMALL GROUP DISCUSSION II  Listed on Pg. 24
           Jigsaw Discussion of Framework Dimensions

11:00 a.m. SMALL GROUP DISCUSSION III  Listed on Pg. 20
           Creation of Draft Framework Dimensions

12:00 p.m. LUNCH & PLENARY DISCUSSION  Ontiveros ABC
           Synthesis of Framework Dimensions & Process for Framework Development
1:30 p.m.  **PLENARY PRESENTATION**  
*Effective Framework Implementation - Teamwork and Leadership*  
*Ontiveros ABC*

1:45 p.m.  **SMALL GROUP DISCUSSION IV**  
*Campus Contributions to Framework Development*  
*Listed on Pg. 20*

2:30 p.m.  **CLOSING PANEL**  
*Feedback from Experts on Framework Dimensions*  
*Ontiveros ABC*

3:00 p.m.  **NEXT STEPS & WRAP UP**  
*Ontiveros ABC*

3:30 p.m.  **CONCLUSION**

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**With Gratitude**

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Project Kaleidoscope at the Association of American Colleges & Universities  

thanks the W.M. Keck Foundation for making this event possible through their financial support.

We also thank the event leadership and presenters for their contributions towards this event and  

California State University, Fullerton for its hospitality.
This initiative aims to develop a comprehensive, institutional STEM Effectiveness Framework that will help campus leaders translate national recommendations for improving student learning and success in STEM into scalable and sustainable actions. The project will engage up to twelve selected colleges and universities in California to test evidence-based strategies that will lead to program, departmental, and eventually, institutional transformation.

The project leverages PKAL’s twenty years of STEM education research and reform experience in creating more effective curricular, teaching, and program strategies. Participating campuses will contribute to the development of a new framework that colleges and universities can use to measure their effectiveness in promoting more learner-centered campus cultures in STEM. The project will pay specific attention to program and institutional data that can be used to evaluate student achievement, experiences, and progress (e.g., rates of transfer, retention, and completion).

The distinctive impact of this project will be that for the first time, faculty and campus leaders will have an explicit tool through which to implement strategies that improve recruitment, access, retention, learning, and completion for all students in all STEM disciplines. The ultimate goal for this tool is to help campuses significantly improve student recruitment, access, retention, learning, and completion – particularly for under represented students - in more STEM courses and programs in California and across the nation.

The four-year project will involve teams of faculty, administrators, and assessment experts at selected institutions in California. Overall, campuses who commit to participating in the project will help develop and test the Framework in the context of their institutional priorities and resources, send a team to the annual project meetings, participate in quarterly project conference calls/webinars, and share their work with others for the final report and dissemination activities of the project.
Welcome Reception

Project Goals & Overview

Time: 5:00 - 6:00 p.m.                    Date: April 26, 2012
Location: Courtyard

Facilitators:

- Adrianna Kezar
  Associate Professor for Higher Education
  University of Southern California
- Susan Elrod
  Executive Director of Project Kaleidoscope
  Project Kaleidoscope/AAC&U

Meeting Goals:

1. Create a draft framework for articulating the dimensions, measures, and processes for improving undergraduate STEM student learning, achievement, and success at the program, department, college, and institutional levels.

2. Bring participating campuses together to share and learn from one another regarding effective practices for improving STEM education.

3. Establish a process and timeline for further framework development by campus teams and project leaders.

Institutions that focus attention and resources on the academic performance of students of all races in first-year science courses are much more likely to be effective in helping students in general—and minority students in particular—succeed. The most effective strategy for beginning the process of institutional culture change involves the use of focus groups designed to hear the perspectives of faculty, staff, and students about why students either achieve or do not. These conversations are crucial, because culture change requires careful self-reflection, robust dialogue, and rigorous analysis, both qualitative and quantitative, to understand trends in academic performance as a result of different intervention strategies. At UMBC, when we think about the culture of an institution, we think about our values, our practices, our habits, and even the relationships among faculty, staff, and students. The more inclusive the discussions are, the greater is the likelihood of getting broad support for institutional change and for building and taking advantage of the creativity of faculty members and students in problem solving.

DINNER & PANEL

NATIONAL PERSPECTIVES ON BENCHMARKING STEM STUDENT SUCCESS

Time: 6:00 - 7:30 p.m.                   Date: April 26, 2012                   Location: Salon AB

Facilitators:
- Adrianna Kezar
  Associate Professor for Higher Education
  University of Southern California
- Susan Elrod
  Executive Director of Project Kaleidoscope
  Project Kaleidoscope/AAC&U

Panelists:
- Peggy Maki
  Education Consultant Specializing in Assessing Student Learning
- Linda Slakey
  Senior Fellow
  Project Kaleidoscope/AAC&U
- Barbar Wright
  Vice President
  Western Association of Schools and Colleges

Notes:

Source: Word Cloud from Pre-event Survey
Question 1: What is motivating you to participate in this project? What would be an ideal outcome for your campus?
PLENARY ACTIVITY

WHAT IS OUR VISION FOR UNDERGRADUATE STEM STUDENT SUCCESS?

Time: 7:30 - 9:00 P.M.                   Date: April 26, 2012                   Location: Salon AB

WHAT WORKS - A PKAL TOOL
A “FANCIFUL HORIZON” EXERCISE

Steps.

DETERMINE YOUR VISION OF AN INSTITUTION THAT EFFECTIVELY PROMOTES UNDERGRADUATE STEM STUDENT LEARNING AND SUCCESS:

1. Begin in self-assembled groups of 4; identify 1 person to keep the group “on task” moving toward the fanciful horizon.

2. Each person in the group generates ~ 4 ideas (words or short phrases) that could describe the ideal undergraduate institution vision; these should be written on the purple post-it notes on the tables (5 minutes).

3. Each person reads his/her ideas to the group of 4, collectively deciding which is mundane, which magical, sticking the purple post-it notes on the left ½ of the flip chart paper (on the table) in the appropriate box (7 minutes) - see diagram next page.

4. The group collectively reviews the ideas, considers if patterns are emerging, if mundane visions can be tweaked to become more magical, if magical visions can be revisited to become more realistic; write your vision on a yellow post-it note, and place it in the “sweet spot” on the paper (10 minutes).

DEVELOP MAGICAL STRATEGIES TO REALIZE YOUR VISION, REPEATING THE EARLIER STEPS:

5. Each person generates ~ 4 ideas (words or short phrases) that could describe specific strategies that a community could take to achieve such a vision; these can be written on any of the post-it notes except purple or yellow (5 minutes).

6. The ideas are again shared, with collective consideration as to which is mundane, which magical, placing colored post-it notes on the right ½ of the page (10 minutes).

7. Identify the least mundane, most magical, out-of-the-box strategy to realizing your vision, write your strategy in the “sweet box” — your color choice (5 minutes).

In the summer of 2007, the PKAL community was introduced to a “Fanciful Horizon” exercise by a team from the Olin School of Engineering.

This exercise was adapted from one used in their introductory engineering course; it also reflects the planning process that preceded the opening of the new Franklin W. Olin School of Engineering.

The exercise is a structured, collaborative approach for identifying and shaping out-of-the-box ideas that can push an organization toward a horizon more fanciful and creative, more transformative than otherwise might be imagined.

— Special Thanks to: Benjamin Linder, Debbie Chachra, and Mark Somerville of the Franklin W. Olin School of Engineering.
PLENARY ACTIVITY

WHAT IS OUR VISION FOR UNDERGRADUATE STEM STUDENT SUCCESS?
TIME: 7:30 - 9:00 P.M.                DATE: APRIL 26, 2012          LOCATION: SALON AB

BUILD AND SHARE YOUR VISION AND STRATEGIES:

8. Combine into groups of 8; share “vision” ideas in the “sweet spot;” develop a common vision that can be described in one sentence (5 minutes).

9. Using pieces of Lego from the collective box, build a model of your vision engaging the group of 8 (we will see how long the groups need).

10. Prepare in writing on a large post-it note or flip chart paper:
• your collective vision
• and the one or two most magical strategies to realize that vision.

11. Describe, clarify and defend your vision and strategies to the assembled group; fun for all.

Next Day:
Before 7:45 a.m.  Checkout from Hotel
8:00 a.m.  Breakfast at CSU Fullerton
Location: Ontiveros ABC in the Titan Student Union
In Roger’s Diffusion of Innovations (2003) seminal synthesis of the research on propagation of innovations, factors that Rogers identified as influencing the extent and rapidity with which innovations spread might be grouped into three sets:

- Perceived attributes of the innovation, i.e., how do potential innovation adapters perceive the innovation?
- Characterization of the environment or context in which potential adapters of innovations learn about innovations and make decisions with respect to innovations, i.e., what is known about how potential adapters are influenced by their environment?
- Extent of change agents’ promotion efforts, i.e., what are the approaches that change agents use to promote innovations and how much energy and resources are invested in the promotion efforts?


Facilitators:

- Adrianna Kezar
  Associate Professor for Higher Education
  University of Southern California
- Susan Elrod
  Executive Director of Project Kaleidoscope
  Project Kaleidoscope/AAC&U
EXAMPLE FRAMEWORKS

DIFFERENCES BETWEEN AUDIT, BENCHMARKING AND EVALUATION

<table>
<thead>
<tr>
<th>Aim</th>
<th>Audit</th>
<th>Benchmarking</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measures what is being done</td>
<td>Identifies problem areas and areas of excellence</td>
<td>Assesses the value of what is being done</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>A cyclical series of reviews</td>
<td>An ongoing process</td>
<td>A series of individual assessments over time</td>
</tr>
<tr>
<td>Data collection</td>
<td>Collects routine data</td>
<td>Collects data for comparative purposes</td>
<td>Collects routine and complex data</td>
</tr>
<tr>
<td>Methodology</td>
<td>Review of what is actually being done</td>
<td>Review of best practice in the organisation or sector</td>
<td>Evalutative research methodology not necessarily for external comparison purposes</td>
</tr>
<tr>
<td>Purpose</td>
<td>Not possible to generalise from the findings</td>
<td>Possible to make comparisons across a process or sector</td>
<td>Often possible to generalise the findings</td>
</tr>
</tbody>
</table>

Table 1: Differences between audit, benchmarking and evaluation
(Adapted from the PDP Toolkit: see www.pdptoolkit.co.uk)

Source:
This model provides a good template framework to inform the creation, auditing, and benchmarking conceptual pieces.

**Source:**
EXAMPLE FRAMEWORKS

THE PELP COHERENCE FRAMEWORK

Adapted from Tushman and O'Reilly's Congruence Model, 2002

Source:
Public Education Leadership Project at Harvard University
http://www.hbs.edu/pelp/framework.html
EXAMPLE FRAMEWORKS

LEARNING BY DESIGN

<table>
<thead>
<tr>
<th>EDUCATION Learning Community</th>
<th>CURRICULUM Learning Framework</th>
<th>PEDAGOGY Learning Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Aims</td>
<td>➢ Learning Domain</td>
<td>➢ Learning Focus</td>
</tr>
<tr>
<td>➢ Conditions</td>
<td>➢ Learning Aims</td>
<td>➢ Knowledge Objectives</td>
</tr>
<tr>
<td>➢ Action Plan</td>
<td>➢ Learning Map</td>
<td>➢ Knowledge Processes</td>
</tr>
<tr>
<td>➢ Outcomes</td>
<td>➢ Assessment</td>
<td>➢ Knowledge Outcomes</td>
</tr>
<tr>
<td></td>
<td>➢ Learning Evaluation</td>
<td>➢ Learning Pathways</td>
</tr>
</tbody>
</table>

Source:
Learning by Design
http://newlearningonline.com/learning-by-design/principles/
## EXAMPLE FRAMEWORKS

### ADDITIONAL MODELS

<table>
<thead>
<tr>
<th>Framework</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubric for Institutional STEM Engagement (RISE)</td>
<td>47</td>
</tr>
<tr>
<td>The Educational Effectiveness Framework (Western Association of Schools &amp; Colleges [WASC])</td>
<td>50</td>
</tr>
<tr>
<td>New Leadership Alliance for Student Learning &amp; Accountability (NLASLA)</td>
<td>53</td>
</tr>
<tr>
<td><a href="http://www.newleadershipalliance.org/">http://www.newleadershipalliance.org/</a></td>
<td></td>
</tr>
<tr>
<td>The 5 Imperatives of Teacher Education (Science &amp; Mathematics Teacher Imperative [SMTI])</td>
<td>59</td>
</tr>
<tr>
<td>Core Commitments 10 Markers of Campus Culture (AAC&amp;U)</td>
<td>73</td>
</tr>
<tr>
<td><a href="http://www.aacu.org/core_commitments/documents/TenMarkersofCampusCulturePDF_000.pdf">http://www.aacu.org/core_commitments/documents/TenMarkersofCampusCulturePDF_000.pdf</a></td>
<td></td>
</tr>
<tr>
<td>The Personal and Social Responsibility Inventory (PSRI) Institutional Matrix (AAC&amp;U)</td>
<td>75</td>
</tr>
<tr>
<td><a href="http://www.aacu.org/core_commitments/PSRI.cfm">http://www.aacu.org/core_commitments/PSRI.cfm</a></td>
<td></td>
</tr>
<tr>
<td>Equity Score Card (Center for Urban Education, University of Southern California)</td>
<td>79</td>
</tr>
<tr>
<td><a href="http://cue.usc.edu/our_tools/the_equity_scorecard.html">http://cue.usc.edu/our_tools/the_equity_scorecard.html</a></td>
<td></td>
</tr>
</tbody>
</table>
Draft STEM Education Effectiveness Framework  
Keck/PKAL Project Meeting: April 26-27, 2012

Vision: ______________________________________________________________________________________________________________________________________

The draft Framework below contains suggested categories of key dimensions of campus work as well as possible questions to guide campus work. EXAMPLE responses to the questions in Row 1 have been provided to prompt team discussions.

<table>
<thead>
<tr>
<th>Dimensions: In what key areas does the campus need to work to achieve this vision?</th>
<th>A. What does it look like?</th>
<th>B. What are the goals and measurable outcomes?</th>
<th>C. How will we know we are successful? What benchmarks will be used?</th>
<th>D. How are we doing? Where are the gaps? What are the challenges we face?</th>
<th>E. What interventions will we need to implement to reach our goals and vision?</th>
<th>F. How will we operate and learn as an organization?</th>
<th>G. How will we document our progress and success?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Institution Learning and Leadership</strong></td>
<td>• Mission statement that contains language regarding STEM student success vision</td>
<td>• Increase graduation of underrepresented minority (URM) students in STEM</td>
<td>• Collect and monitor graduation rates</td>
<td>• Currently, only 30% URM students graduate in STEM</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>a. mission and educational purpose</td>
<td>b. organizational learning</td>
<td>c. campus culture</td>
<td>d. policies and procedures, including faculty rewards and incentives</td>
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</tr>
<tr>
<td><strong>2. Faculty work related to educational mission/objectives</strong></td>
<td>• Clearly articulated learning outcomes</td>
<td>• Establish learning outcome statements</td>
<td>• Review course syllabi</td>
<td>• Inventory courses for pedagogies employed by faculty members</td>
<td>• Faculty learning communities</td>
<td>• Advisory Committee with representatives from CTL and science college will be created</td>
<td>• Regular progress reports to campus community</td>
</tr>
<tr>
<td>a. quality of learning</td>
<td>b. assessment</td>
<td>c. program design</td>
<td>d. program culture</td>
<td>e. faculty development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3. Student Success</strong></td>
<td>• STEM student success goals have been defined</td>
<td>• Collect and monitor retention rates, transfer rates, completion rates by race, major, etc.</td>
<td>• Cost analysis of course failure</td>
<td>• Use data for department discussions regarding student success goals</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>a. measures of success</td>
<td>b. support programs</td>
<td>c. co/extra-curricular experiences</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4. External stakeholders and partners</strong></td>
<td>• P-16 STEM council with local K-12, business and civic leaders</td>
<td>• Stakeholders are involved in programs</td>
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</tbody>
</table>
THE FIVE PHASES OF THE EQUITY SCORECARD™ PROCESS

Phase 1: Laying the Groundwork
CUE facilitators collaborate with campus/system leadership to align the Scorecard with existing efforts and identify individuals to serve on the evidence team. The team meets to learn about data and the use of CUE’s tools.

Phase 2: Defining the Problem
Evidence team members use the Vital Signs as a starting point to investigate campus data and increase their knowledge about existing student outcomes.

Phase 3: Assessing Interventions
The evidence team uses the Benchmarking Equity and Student Success Tool™ (BESST) to identify and prioritize intervention points. They then identify institutional practices that positively or adversely affect student success through the use of Self-Assessment Inventories.

Phase 4: Implementing Solutions
The evidence team sets short-term, actionable objectives and long-term equity goals for priority areas of concern.

Phase 5: Evaluating Results
The evidence team completes the Equity Scorecard™ and with CUE’s support shares its findings and goals with the system/campus.

What aspects of these Frameworks are valuable to your institutional context?

1. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

2. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

3. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

CONTINUED ---->
(We’re) not just looking at what students are or are not doing, and focusing on student deficits, but thinking about what the institution can do differently. This is different from other work that has been done.

— Center for Urban Education: http://cue.usc.edu/our_tools/the_equity_scorecard.html
SMALL GROUP DISCUSSION I

DISCUSSION OF FRAMEWORK MODELS

TIME: 9:30 - 10:30 A.M.      DATE: APRIL 27, 2012      LOCATION: ASSIGNMENTS LISTED BELOW

Campus teams to review Framework models and discuss dimensions most useful in constructing an institutional STEM education framework. Use the table on pages 22-23 to create a revised set of dimensions. Be prepared to share with other campuses in the next discussion session.

Meeting Room Assignments:

<table>
<thead>
<tr>
<th>Room</th>
<th>Team</th>
<th>Advisors/Observers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontiveros ABC</td>
<td>CSUPERB&lt;br&gt;California State University, Fullerton&lt;br&gt;University of La Verne</td>
<td>Susan Elrod&lt;br&gt;Michael Burke</td>
</tr>
<tr>
<td>Alvarado A</td>
<td>California State University, Los Angeles&lt;br&gt;W.M. Keck Science Department</td>
<td>Barbara Wright&lt;br&gt;Shawn Gaillard&lt;br&gt;Carol Mattson</td>
</tr>
<tr>
<td>Alvarado B</td>
<td>California State University, Long Beach&lt;br&gt;San Diego State</td>
<td>Linda Slakey&lt;br&gt;Carol Comeau&lt;br&gt;Wayne Tikkanen</td>
</tr>
<tr>
<td>Tuffree A</td>
<td>San Francisco State University&lt;br&gt;University of California, Davis</td>
<td>Peggy Maki&lt;br&gt;Richard Fee&lt;br&gt;Sean Gehrke</td>
</tr>
<tr>
<td>Tuffree B</td>
<td>California State University, East Bay&lt;br&gt;University of San Diego</td>
<td>Adrianna Keszar&lt;br&gt;Dana Hester&lt;br&gt;Cecilia Santiago</td>
</tr>
</tbody>
</table>
## SMALL GROUP DISCUSSION I

### DISCUSSION OF FRAMEWORK MODELS

**Time:** 9:30 - 10:30 A.M.  
**Date:** April 27, 2012  
**Location:** See Assignments

<table>
<thead>
<tr>
<th>Dimensions: In what key areas does the campus need to work to achieve this vision?</th>
<th>Characteristics: What does it look like?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Institutional learning and leadership:</td>
<td></td>
</tr>
<tr>
<td>2. Faculty work related to educational mission objectives:</td>
<td></td>
</tr>
<tr>
<td>3. Student success:</td>
<td></td>
</tr>
</tbody>
</table>
**SMALL GROUP DISCUSSION I**

**DISCUSSION OF FRAMEWORK MODELS**

**TIME:** 9:30 - 10:30 A.M.  **DATE:** APRIL 27, 2012  **LOCATION:** SEE ASSIGNMENTS

<table>
<thead>
<tr>
<th>Dimensions: In what key areas does the campus need to work to achieve this vision?</th>
<th>Characteristics: What does it look like?</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. External stakeholders and partners:</td>
<td></td>
</tr>
<tr>
<td>5. _____________________________________________</td>
<td></td>
</tr>
<tr>
<td>6. _____________________________________________</td>
<td></td>
</tr>
</tbody>
</table>
Based on extensive research about students’ choices, learning processes, and preparation, three imperatives underpin this report:

- Improve the first two years of STEM education in college.
- Provide all students with the tools to excel.
- Diversify pathways to STEM degrees.


Cross campus teams share with each other.

### Meeting Room Assignments:

<table>
<thead>
<tr>
<th>Ontiveros ABC: Susan Elrod</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>David Connors</td>
<td>Susan Baxter</td>
</tr>
<tr>
<td></td>
<td>Mary Hatcher-Skeers</td>
<td>Carol Comeau</td>
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<td></td>
<td>Robert Koch</td>
<td>Shawn Drew Gaillard</td>
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<tr>
<td></td>
<td>Carol Mattson</td>
<td>Mary Sue Lowery</td>
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<tr>
<td></td>
<td>Kathleen Weaver</td>
<td>Kathy Williams</td>
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<tr>
<td>Tuffree A: Peggy Maki</td>
<td>Group 3</td>
<td>Group 4</td>
</tr>
<tr>
<td></td>
<td>Carmen Domingo</td>
<td>Sean Gehrke</td>
</tr>
<tr>
<td></td>
<td>Amber Machamer</td>
<td>Susan Gomez-Zwiep</td>
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<tr>
<td></td>
<td>Marco Molinaro</td>
<td>William Hoese</td>
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<tr>
<td></td>
<td>Cecilia Santiago</td>
<td>Cheryl Ney</td>
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<tr>
<td>Tuffree B: Adrianna Kezar</td>
<td>Group 5</td>
<td>Group 6</td>
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<tr>
<td></td>
<td>Auro Alegra Eoy-Reveles</td>
<td>Judy Botelho</td>
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<td></td>
<td>Richard Fee</td>
<td>Michael Burke</td>
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<td></td>
<td>Pamela Huntzinger</td>
<td>Geoff Chase</td>
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<td></td>
<td>Chung-Hsing Ouyang</td>
<td>Carole Logan Huston</td>
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<tr>
<td>Alvarado A: Barbara Wright</td>
<td>Group 7</td>
<td>Group 8</td>
</tr>
<tr>
<td></td>
<td>Susan Opp</td>
<td>Felicia Beardsley</td>
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<tr>
<td></td>
<td>Chris Pagliarulo</td>
<td>Bidushri Bhattacharya</td>
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<tr>
<td></td>
<td>Kimberly Tanner</td>
<td>Michael Loverude</td>
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<tr>
<td></td>
<td>Wayne Tikkamanen</td>
<td>James Rudd</td>
</tr>
<tr>
<td>Alvarado B: Linda Slakey</td>
<td>Group 9</td>
<td>Group 10</td>
</tr>
<tr>
<td></td>
<td>Cathie Atkins</td>
<td>David Hansen</td>
</tr>
<tr>
<td></td>
<td>Henry Fung</td>
<td>Jonathan Reed</td>
</tr>
<tr>
<td></td>
<td>Dana Hester</td>
<td>Edward Sullivan</td>
</tr>
<tr>
<td></td>
<td>Sarah Kriz</td>
<td>Kelly Young</td>
</tr>
</tbody>
</table>
SMALL GROUP DISCUSSION II

JIGSAW DISCUSSION OF FRAMEWORK ELEMENTS

TIME: 10:30 - 11:00 A.M.     DATE: APRIL 27, 2012     LOCATION: SEE ASSIGNMENTS

Notes:

STEPS TO INCREASE COMPLETION AND QUALITY IN HIGHER EDUCATION

1. Clearly articulate learning outcomes calibrated to today’s challenges in work, life, and citizenship.

2. Map curricular options and requirements to those outcomes.

3. Collect disaggregated data on students’ access to and achievement in high-impact educational practices.

4. Incentivize through funding the expansion of access to and use of high-impact practice in classrooms, programs, institutions, and systems.

5. Collect data on students’ progress through programs and their levels of successful remediation, transfer, and degree completion.

6. Collect and report on both qualitative and quantitative assessments of student learning—focusing on assessments of students’ ability to apply their learning to complex real-world problems.

— Humphrey, Debra. 2012. “What’s Wrong with the Completion Agenda—And What We Can Do About It.” Liberal Education 98 (1).
SMALL GROUP DISCUSSION III

CREATION OF DRAFT FRAMEWORK DIMENSIONS

**TIME:** 11:00 A.M. - 12:00 P.M.  **DATE:** APRIL 27, 2012  **LOCATION:** SAME ROOMS AS DISCUSSION 1

Campus teams to create desired dimensions of a draft framework. Teams will create a poster for report out at lunch.

<table>
<thead>
<tr>
<th>Dimensions: In what key areas does the campus need to work to achieve this vision?</th>
<th>Characteristics: What does it look like?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Institutional learning and leadership:</td>
<td></td>
</tr>
<tr>
<td>2. Faculty work related to educational mission objectives:</td>
<td></td>
</tr>
<tr>
<td>3. Student success:</td>
<td></td>
</tr>
</tbody>
</table>
## SMALL GROUP DISCUSSION III

### CREATION OF DRAFT FRAMEWORK DIMENSIONS

**TIME:** 11:00 A.M. - 12:00 P.M.  
**DATE:** APRIL 27, 2012  
**LOCATION:** SAME ROOMS AS DISCUSSION 1

<table>
<thead>
<tr>
<th>Dimensions: In what key areas does the campus need to work to achieve this vision?</th>
<th>Characteristics: What does it look like?</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. External stakeholders and partners:</td>
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<td>5. _________________________________</td>
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<tr>
<td>6. _________________________________</td>
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</tr>
</tbody>
</table>
REPORT OUT OF FRAMEWORK DISCUSSION

Time: 12:00 - 1:00 P.M.  Date: April 27, 2012  Location: Ontiveros ABC

Facilitators:

- Adrianna Kezar
  Associate Professor for Higher Education
  University of Southern California

- Susan Elrod
  Executive Director of Project Kaleidoscope
  Project Kaleidoscope/AAC&U

Notes:
LUNCH

SYNTHESIS OF FRAMEWORK DIMENSIONS & PROCESS FOR FRAMEWORK DEVELOPMENT

TIME: 1:00 - 1:30 P.M.  DATE: APRIL 27, 2012  LOCATION: ONTIVEROS ABC

Facilitators:

- Adrianna Kezar
  Associate Professor for Higher Education
  University of Southern California
- Susan Elrod
  Executive Director of Project Kaleidoscope
  Project Kaleidoscope/AAC&U

Refer to Framework Handout. For one of the dimensions, brainstorm answers to the questions in the Framework.

Notes:

Best Idea:

Resource:

Initial List of Sources of Evidence on next page
SOURCES OF EVIDENCE & DATA REGARDING STUDENT LEARNING & SUCCESS

AN INITIAL LIST

Basic data:
Graduation rates
Information found in IPEDS Common Data Set (http://nces.ed.gov/ipeds/)
Units completed
Course retention
Change of major
Course grades
GPA
Math placement scores
AP scores
SAT, ACT scores
Statistics on remedial courses required

Direct measures of learning:
Concept inventories Major field tests (ETS) (http://en.wikipedia.org/wiki/Concept_inventory), ACS tests or other discipline-specific exams
Embedded exam questions
Student projects (evaluated using a rubric, e.g., AAC&U VALUE rubrics (http://www.aacu.org/value/))
E-portfolio collections of student work

Indirect measures:
NSSE survey (http://nsse.iub.edu/)
FSSE survey (http://fsse.iub.edu/)
CCSSE survey (http://www.ccssse.org/)
CIRP freshman survey (http://www.heri.ucla.edu/cirpoverview.php)
End of course student evaluations (e.g., IDEA, SALG)
HERI faculty survey (http://www.heri.ucla.edu/facoverview.php)
Student focus groups, interviews of other surveys of program effectiveness, satisfaction
SURE (Survey of Undergraduate Research Experiences) and CURE (Classroom Undergraduate Research Experiences) Surveys (http://www.grinnell.edu/academic/psychology/faculty/dl/surecur)
RISC (Research on the Integrated Science Curriculum) Survey (http://www.grinnell.edu/academic/psychology/faculty/dl/risc)

Measures of faculty effectiveness:
RTOP (Reformed Teaching Observation Protocol; http://physicsed.buffalostate.edu/AZTEC/RTOP/RTOP_full/) or other measures of classroom engagement

Campus documents and reports:
Course syllabi
Advising documents
Curriculum maps/catalog information
Program Review reports
Regional accreditation reports
Project reports from funded programs or grants

Research methods/Processes for addressing:
Cohort studies of different student populations
Disaggregation of data by different student populations
Sampling methodology used for assessment of student projects, exam questions, laboratory reports or other learning artifacts
Analysis of student and faculty survey data
Ethnographic or qualitative studies
Comparison studies across majors, courses or peer/aspirational institutions
PLENARY PRESENTATION

EFFECTIVE FRAMEWORK IMPLEMENTATION - TEAM WORK & LEADERSHIP

Time: 1:30 - 1:45 p.m.               Date: April 27, 2012               Location: Ontiveros ABC

“Collaboration is extremely difficult because not only are our organizations based on principles and structures antithetical to collaboration, so are our larger systems of government, foundations, disciplinary societies, and the like. So, the challenges exist within all parts of the system. Leaders . . . will be more successful encouraging collaboration if they can acknowledge their own challenges in collaborating, learn from these experiences, and try to be role models for higher education – a system that is even more embedded in an ethic that prevents collaboration.”


Facilitator:

- Adrianna Kezar
  Associate Professor for Higher Education
  University of Southern California

Notes:
PLENARY PRESENTATION

EFFECTIVE FRAMEWORK IMPLEMENTATION - TEAM WORK & LEADERSHIP

Time: 1:30 - 1:45 p.m.       Date: April 27, 2012       Location: Ontiveros ABC

FROM BOEING AIRCRAFT GROUP TEAM MEMBER TRAINING MANUAL (EXCERPTS):

• EVERY member is responsible for the team’s progress and success

• Listen to and show respect for the contributions of other members; be an active listener.

• CONSTRUCTIVELY criticize ideas, not persons.

• Only one person speaks at a time.

• Everyone participates; no one dominates.

• Be succinct—avoid long anecdotes and examples.

• No rank in the room.

• Ask questions when you do not understand.

• Attend to your personal comfort needs at any time, but minimize team disruption.

• HAVE FUN!!

— With special thanks to Karl Smith, University of Minnesota.

Best Idea:
SMALL GROUP DISCUSSION IV

CAMPUS CONTRIBUTIONS TO FRAMEWORK DEVELOPMENT

Time: 1:45 - 2:30 P.M.       Date: April 27, 2012       Location: Same Rooms as Discussion 1

Facilitator:

Susan Elrod
Executive Director of Project Kaleidoscope
Project Kaleidoscope/AAC&U

1. Which dimensions will our campus team focus on for further development?

2. Who will be on the team? Who will lead the team?

3. What are the characteristics of a good team?
4. What will be our process? Timeline?
   Note: Final plans due in June 2012. Interim report on progress due in January 2013.

5. What expertise/help do we need from other campuses or project teams?

A collective commitment to assessing for learning is anchored in the following:

1. Intellectual curiosity about student learning.

2. The demographic spread of students at each of our institutions that leads to chronological reporting of results against that spread to humanize and democratize the assessment process, not standardize it.

3. Positions of inquiry that enable educators, students and the institution itself to view and self-reflect on learning.

4. Scholarly inquiry into assessment of student learning to deepen the usefulness of assessment results.

5. Roles and responsibilities across an institution to sustain an institutional commitment to the assessment process.


Resource:
Draft STEM Education Effectiveness Framework on Pg. 16
CLOSING PANEL

FEEDBACK FROM EXPERTS ON FRAMEWORK DIMENSIONS

Time: 2:30 - 3:00 p.m.                   Date: April 27, 2012               Location: Ontiveros ABC

Facilitators:
- Adrianna Kezar
  Associate Professor for Higher Education
  University of Southern California
- Susan Elrod
  Executive Director of Project Kaleidoscope
  Project Kaleidoscope/AAC&U

Panelists:
- Peggy Maki
  Education Consultant Specializing in Assessing Student Learning
- Linda Slakey
  Senior Fellow
  Project Kaleidoscope/AAC&U
- Barbar Wright
  Vice President
  Western Association of Schools and Colleges

CLOSING PANEL

FEEDBACK FROM EXPERTS ON FRAMEWORK DIMENSIONS

Time: 2:30 - 3:00 p.m.  Date: April 27, 2012  Location: Ontiveros ABC

Notes:

Best Idea:
NEXT STEPS & WRAP UP

What are ways in which:

1. You can gain the expertise and help you need to be successful?

2. You can share your expertise with each other?

3. The project can help you in your efforts to participate in development of the Framework and advance your campus work in STEM education?
NOTES:

Source: Word Cloud from Pre-event Survey

Question 3: What areas of expertise would you be interested in learning more about (via project experts, project webinars, or other resources) that would help to advance your work in improving undergraduate STEM student learning, achievement, and success?
### PROJECT TIMELINE & KEY MILESTONES

#### YEAR ONE

**Year One Goal:** Framework development will occur by presenting a draft of the audit, rubric, and benchmarking tools to assembled campus teams at the first project meeting. Campuses will discuss the draft, bringing their campus experience and priorities to bear on the discussion. They will then spend 6 months working on their campus to further develop and refine a component of the Framework that best matches their institutional context, experience, and priorities.

<table>
<thead>
<tr>
<th>Objectives/Aims</th>
<th>Timeline</th>
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</thead>
<tbody>
<tr>
<td><strong>Year 1 (Jan 2012 - Dec 2012):</strong></td>
<td><strong>April 2012:</strong></td>
</tr>
<tr>
<td>Overall objective – creation of a draft STEM Effectiveness Framework</td>
<td>1. Campus leaders meet together to provide feedback on components of the Framework 1.0, campuses create plans for developing details, resources, and metrics for one or more aspects of the framework.</td>
</tr>
<tr>
<td>A. Create drafts of Framework components for initial meeting of campus leaders.</td>
<td>2. Evaluation of meeting goals; use of meeting outcomes to inform formative evaluation.</td>
</tr>
<tr>
<td>B. Campuses work to refine Framework dimensions to further develop Framework details.</td>
<td><strong>August 1, 2012:</strong></td>
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<tr>
<td><strong>August 2012 - December 2012:</strong></td>
<td><strong>August 2012 - December 2012:</strong></td>
</tr>
<tr>
<td>1. Campuses execute plans, leveraging campus initiatives and priorities, using campus resources, and connecting with national experts to advise and guide their work as needed.</td>
<td>1. Campuses execute plans, leveraging campus initiatives and priorities, using campus resources, and connecting with national experts to advise and guide their work as needed.</td>
</tr>
<tr>
<td>2. PKAL will communicate regularly with the campus lead for each campus to monitor progress, organize regular conference calls and webinars among campuses working on similar issues, and provide an online venue for them to share their work.</td>
<td>2. PKAL will communicate regularly with the campus lead for each campus to monitor progress, organize regular conference calls and webinars among campuses working on similar issues, and provide an online venue for them to share their work.</td>
</tr>
<tr>
<td>3. Campuses in Southern California will participate in the SoCal PKAL network at the fall meeting.</td>
<td>3. Campuses in Southern California will participate in the SoCal PKAL network at the fall meeting.</td>
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<tr>
<td><strong>December 2012:</strong></td>
<td><strong>December 2012:</strong></td>
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<tr>
<td>2. Formative evaluation continues using information in reports.</td>
<td>2. Formative evaluation continues using information in reports.</td>
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</table>
**PROJECT TIMELINE & KEY MILESTONES**

**YEAR TWO**

**Year Two:** A revised Framework will be tested on each campus. Campuses will complete the audit and develop plans for using the rubric and benchmarking tools, including collecting and analyzing their own campus data, reviewing appropriate campus policies, systems and infrastructure issues, and plotting a course for using the tools to make progress on their own STEM learning and success goals. A diverse team of faculty, staff, and administrators will carry out this work on each campus.

<table>
<thead>
<tr>
<th>Objectives/Aims</th>
<th>Timeline</th>
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</thead>
</table>
| **Year 2 (January 2013 - December 2013):** | **January - March 2013:**
Overall objective – Revision and use of the STEM Effectiveness Framework, version 2.0 | PI and evaluator use information provided in campus reports to develop a revised Framework, version 2.0, which will be disseminated to participating campuses in preparation for April meeting of campus leaders. |
| A. Revised Framework (version 2.0) developed, informed by campus work during Year 1 | **April 2013:**
1. Campus leaders meet together to review Framework 2.0 and develop plans for using it to develop specific strategies for making strategic changes in STEM education. |
| B. Campuses use aspects of Framework 2.0 to work toward improving STEM learning and success in ways that are aligned with their institutional mission and priorities. | 2. Evaluation of meeting goals; use of meeting outcomes to inform formative evaluation. |
| C. Campuses develop and test strategies for achieving desired goals in the context of the Framework. | **August 1, 2013:**
Campuses submit plans for use of Framework 2.0. |
| D. Evaluation activities - Continue formative evaluation | **August 2013 - December 2013:**
1. Campuses execute plans, leveraging campus initiatives and priorities, using campus resources, and connecting with national experts to advise and guide their work as needed. |
| | 2. PKAL will continue to communicate regularly with the campus lead for each campus to monitor progress, including organizing conference calls and/or webinars and providing an online venue for them to share their work. |
| | 3. Campuses in Southern California participate in and share results with SoCal PKAL network at regular meetings. |
| | **December 2013:**
1. Campuses submit progress reports of their work using the Framework. |
| | 2. Formative evaluation completed. |
**PROJECT TIMELINE & KEY MILESTONES**

**YEARS THREE & FOUR**

*Years Three and Four*: Feedback on the usefulness of the Framework for planning and making progress toward reaching improved STEM learning and success will be collected after campuses have continued to carry out their plans using the Framework. A final Framework and analysis of its use will be completed. In year four a final version of the Framework will be disseminated and published with campus case studies, methods, and other useful resources for implementing change using the Framework.

<table>
<thead>
<tr>
<th>Objectives/Aims</th>
<th>Timeline</th>
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</thead>
<tbody>
<tr>
<td><strong>Year 3 (January 2014 - December 2014):</strong> Overall objective - Produce final version of the Framework and evaluate its formative use by campuses.</td>
<td><strong>January 2014 - June 2014:</strong> 1. Campuses continue to execute plans to implement the Framework to make strategic changes in STEM education. 2. PKAL will continue to communicate regularly with the campus lead for each campus to monitor progress, including organizing conference calls and/or webinars and providing an online venue for them to share their work. 3. Campuses in Southern California participate in and share results with SoCal PKAL network at regular meetings.</td>
</tr>
<tr>
<td>A. Obtain feedback from campuses regarding use of the Framework; revise as needed.</td>
<td>4. Campuses submit final reports of results using the Framework.</td>
</tr>
<tr>
<td>B. Assess campus progress using the Framework.</td>
<td><strong>June - July 2014:</strong> 5. PKAL will develop a final version of the Framework. The final Framework will be disseminated to participating campuses in preparation for the final project meeting in August.</td>
</tr>
<tr>
<td>C. Begin summative evaluation of how use of the Framework helped catalyze broader institutional change in STEM education.</td>
<td><strong>August 2014:</strong> 6. Campus leaders meet for the final time to share their campus progress, challenges and impacts of using the Framework, and to provide final feedback on the Framework.</td>
</tr>
<tr>
<td>D. Disseminate Framework.</td>
<td><strong>September 2014:</strong> 7. Final version of the Framework disseminated to participating campuses for final comments and revision.</td>
</tr>
</tbody>
</table>
# PROJECT TIMELINE & KEY MILESTONES

* YEAR FOUR CONTINUED *

<table>
<thead>
<tr>
<th>Objectives/Aims</th>
<th>Timeline</th>
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</thead>
<tbody>
<tr>
<td>Year 4 (January 2015 - August 2015):</td>
<td>January 2015: Draft report of project results published online and presented at AAC&amp;U Annual Meeting and AAAS (American Association for the Advancement of Science) National Conference.</td>
</tr>
<tr>
<td>Dissemination and publication efforts continue.</td>
<td>August 2015: Final report produced and published in print and online.</td>
</tr>
</tbody>
</table>
RESOURCES

Included Resources

Framework Model: Rubric for Institutional STEM Engagement (RISE)................................................................. 47
Framework Model: The Educational Effectiveness Framework (Western Association of Schools & Colleges (WASC))...... 50
Framework Model: New Leadership Alliance for Student Learning & Accountability (NLASLA)
http://www.newleadershipalliance.org/...................................................................................................................... 53
Framework Model: The 5 Imperatives of Teacher Education (Science & Mathematics Teacher Imperative (SMTI))
Framework Model: Core Commitments Ten Markers of Campus Culture (AAC&U)
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Framework Model: The Personal and Social Responsibility Inventory (PSRI) Institutional Matrix (AAC&U)
http://www.aacu.org/core_commitments/PSRI.cfm.................................................................................................... 75
Framework Model: Equity Score Card (Center for Urban Education, University of Southern California)
http://cue.usc.edu/our_tools/the_equity_scorecard.html........................................................................................ 79
Facilitating Interdisciplinary Learning: Lessons from Project Kaleidoscope
Authors: Adrianna Kezar and Susan Elrod................................................................................................................. 81
The Path to Pedagogical Reform in the Sciences: Engaging Mutual Adaptation and Social Movement Models of Change
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<th>Dimension</th>
<th>Importance? (Out of 1-5, where 5 is most important)</th>
<th>Where are we? (Out of 1-5, where 5 is most developed)</th>
<th>Evidence</th>
<th>Next Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. STUDENT LEARNING &amp; ASSESSMENT</strong></td>
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<tr>
<td>A. Student learning outcomes have been established that reflect current knowledge &amp; practice in the field (e.g., new knowledge, integration/interdisciplinary, quantitative literacy, current laboratory skills); outcomes fit into and are consistent with the larger context of the department, college or university mission as well as societal context; outcomes are communicated to students</td>
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<tr>
<td>B. Assessment mechanisms, both formative and summative, have been developed to measure student achievement of outcomes</td>
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<tr>
<td>C. Assessment plans are in place and systematically utilized for program learning &amp; improvement; improvements are documented and utilized for program review and/or accreditation documents</td>
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<td>D. Desired kind and level of learning is achieved</td>
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<tr>
<td>E. Program contributes to student success and preparation for post-graduation goals (including graduate school, professional school, teaching programs, careers); students are satisfied with the program</td>
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<tr>
<td>F. Other</td>
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</tbody>
</table>
### Rubric for Institutional STEM Engagement (RISE)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Importance? (Out of 1-5, where 5 is most important)</th>
<th>Where are we? (Out of 1-5, where 5 is most developed)</th>
<th>Evidence</th>
<th>Next Steps</th>
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</thead>
<tbody>
<tr>
<td><strong>II. TEACHING &amp; LEARNING ENVIRONMENT</strong></td>
<td></td>
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</tr>
<tr>
<td>A. Pedagogy is aligned with program outcomes and assessment measures</td>
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<tr>
<td>B. Interactive-engaging pedagogies are widely utilized throughout the program, in both lecture and lab (e.g., inquiry-based labs, clickers, PLTL or other engaging pedagogies, undergraduate research, community-based projects); real world approaches are utilized; faculty use resources other than textbooks</td>
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<tr>
<td>C. There is a student-centered focus to the curriculum; students are given timely feedback on their progress</td>
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<td>D. There is a culture of inquiry regarding student learning &amp; program improvement; faculty meet regularly to discuss student learning, classroom practice, and program improvement; many faculty members are engaged in the work</td>
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<tr>
<td>E. There are processes and infrastructure in place to support program outcomes, especially if they involve interdisciplinary approaches</td>
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<tr>
<td>F. Faculty are encouraged, supported and rewarded for efforts in teaching &amp; learning, curriculum development &amp; program improvement; professional development opportunities are made available on campus or through regional or national organizations</td>
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<td>G. Research in teaching and learning (Teaching as Research) is an appropriate, acceptable and rewarded faculty professional activity; P &amp; T documents contain clear guidelines and standards for review; sabbaticals are granted for Teaching as Research projects</td>
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<tr>
<td>H. Other</td>
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<tr>
<td>Dimension</td>
<td>Importance? (Out of 1-5, where 5 is most important)</td>
<td>Where are we? (Out of 1-5, where 5 is most developed)</td>
<td>Evidence</td>
<td>Next Steps</td>
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<tr>
<td><strong>III. PROGRAM IMPROVEMENT &amp; CAMPUS LEADERSHIP</strong></td>
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</tr>
<tr>
<td>A. Formal program &amp; campus leadership enables an inclusive culture of inquiry with respect to program outcomes, assessment, classroom practice and program learning; informal leadership is empowered and supported; financial, staffing, facilities and other resources are made available to support the work</td>
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<tr>
<td>B. Formal program &amp; campus leadership supports and rewards faculty members who are engaged in Teaching as Research professional development</td>
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<tr>
<td>C. There are processes and infrastructure in place to support program outcomes, especially if they involve interdisciplinary approaches, and to facilitate program learning &amp; improvement (e.g., committees, learning communities)</td>
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<tr>
<td>D. The program regularly attends regional or national education workshops or conferences, or makes education presentations at scientific society meetings</td>
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<td>E. Students are included as partners in program improvement efforts</td>
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<tr>
<td>F. Program seeks and obtains external funding to support educational research, curriculum transformation, etc.</td>
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<tr>
<td>G. There are symbolic representations that embody the goals, outcomes and achievements of the program (e.g., undergraduate research conference, posters in hallways, displays of student work &amp; awards)</td>
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<tr>
<td>H. Program efforts are aligned with and articulated within the institutional vision/mission and strategic plan</td>
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<tr>
<td>I. Other</td>
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</tr>
</tbody>
</table>
### The Educational Effectiveness Framework: Capacity and Effectiveness as They Relate to Student and Institutional Learning

<table>
<thead>
<tr>
<th>Key Descriptive Terms</th>
<th>ELEMENT &amp; DEFINITION</th>
<th>INITIAL</th>
<th>EMERGING</th>
<th>DEVELOPED</th>
<th>HIGHLY DEVELOPED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning</strong></td>
<td></td>
<td></td>
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<tr>
<td>A. Student learning outcomes established; communicated in syllabi and publications; cited and used by faculty, student affairs, advisors, others (CFRs 2.2, 2.4):</td>
<td>For only a few programs and units; only vaguely (if at all) for GE; not communicated in syllabi, or publications such as catalogues, view books, guides to the major; only a few faculty know and use for designing curriculum, assignments, or assessment</td>
<td>For many programs and units, most aspects of GE; beginning to be communicated in basic documents; beginning to be used by some faculty for design of curriculum, assignments, assessments</td>
<td>For all units (academic &amp; co-curricular), and for all aspects of GE; cited often but not in all appropriate places; most faculty cite; used in most programs for design of curriculum, assignments, and assessment</td>
<td>For all units (academic and co-curricular), and for all aspects of GE; cited widely by faculty and advisors; used routinely by faculty, student affairs, other staff in design of curricula, assignments, co-curriculum, and assessment</td>
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<tr>
<td>B. Expectations are established for how well (i.e., proficiency level) students achieve outcomes (CFRs 2.1, 2.4, 2.5):</td>
<td>Expectations for student learning have not been set beyond course completion and GPA; level of learning expected relative to outcomes unclear</td>
<td>Expectations for level of learning explicit in a few programs; heavy reliance on course completion and GPA</td>
<td>Expectations for student learning explicit in most programs</td>
<td>Expectations for student learning are explicit in all programs, widely known and embraced by faculty, staff, and students</td>
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<tr>
<td>C. Assessment plans are in place; curricular and co-curricular outcomes are systematically assessed, improvements documented (CFRs 2.4, 2.7):</td>
<td>No comprehensive assessment plans. Outcomes assessed occasionally using surveys and self reports, seldom using direct assessment; rarely lead to revision of curriculum, pedagogy, co-curriculum, or other aspects of educational experience</td>
<td>Some planning in place. Outcomes assessed occasionally, principally using surveys; beginning to move toward some direct assessment; occasionally leads to improvements in educational experience; improvements sporadically documented, e.g., in units’ annual reports</td>
<td>Plans mostly in place. Assessment occurs periodically, using direct methods...supplemented by indirect methods and descriptive data; educational experience is frequently improved based on evidence and findings; improvements are documented regularly and findings discussed periodically by most faculty and other campus educators</td>
<td>Assessment plans throughout institution. Assessment occurs on regular schedule using multiple methods; strong reliance on direct methods, performance-based; educational experience systematically reviewed and improved based on evidence and findings; documentation widespread and easy to locate.</td>
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<tr>
<td>D. Desired kind and level of learning is achieved (CFR 2.6):</td>
<td>Possible that learning is not up to expectations, and/or expectations set by institution are too low for degree(s) offered by the institution</td>
<td>Most students appear to achieve at levels set by the institution; faculty and other educators beginning to discuss expectations and assessment findings</td>
<td>Nearly all students achieve at or above levels set by institution; assessment findings discussed periodically by most faculty and other campus educators</td>
<td>All students achieve at or above levels set by institution; findings are discussed regularly and acted upon by all or nearly all faculty and other campus educators</td>
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<tr>
<td><strong>Teaching/Learning Environment</strong></td>
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<tr>
<td>A. Curricula, pedagogy, co-curriculum, other aspects of educational experience are aligned with outcomes (2.1, 2.2, 2.3, 2.4, 2.5, 4.6):</td>
<td>Conceived exclusively or largely in terms of inputs (e.g. library holdings, lab space), curricular requirements (e.g., for majors, GE) and availability of co-curricular programs; not visibly aligned with outcomes or expectations for level of student achievement; evidence of alignment processes lacking</td>
<td>Educational experience beginning to be aligned with learning outcomes and expectations for student achievement; evidence of alignment efforts available in some academic and co-curricular programs</td>
<td>Educational experience generally aligned with learning outcomes, expectations for student achievement; alignment becoming intentional, systematic, supported by tools (e.g. curriculum maps) and processes. Evidence of alignment efforts generally available</td>
<td>Educational experience fully aligned with learning outcomes, expectations; alignment is systematic, supported by tools and processes as well as broader institutional infrastructure. Evidence of alignment efforts readily available</td>
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<tr>
<td>B. Curricular and co-curricular processes (CFRs 2.1, 2.2, 2.3, 2.11, 2.13) are:</td>
<td>Rarely informed by good learning practices as defined by the wider higher education community; few curricular or co-curricular activities reviewed, mostly without reference to outcomes or evidence of student learning</td>
<td>Informed in some instances by good learning practices; curricula and co-curricular activities occasionally reviewed and improved but with little reference to outcomes or assessment findings</td>
<td>Informed in many cases by good learning practices; reviewed and improved by relevant faculty and other campus educators; often based on outcomes and assessment findings</td>
<td>Regularly informed by good learning practices; improvements consistently result from scholarly reflection on outcomes and assessment findings by relevant faculty and other campus educators</td>
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<tr>
<td>Key Descriptive Terms</td>
<td>INITIAL</td>
<td>EMERGING</td>
<td>DEVELOPED</td>
<td>HIGHLY DEVELOPED</td>
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<td><strong>C. Professional development, rewards (CFRs 2.8, 2.9):</strong></td>
<td>Little or no support for faculty, other campus educators to develop expertise in assessment of student learning, related practices; work to assess, improve student learning plays no positive role in reward system, may be viewed as a negative</td>
<td>Some support for faculty, other educators on campus to develop expertise in assessment of student learning, related practices; modest, implicit positive role in reward system</td>
<td>Some support for faculty, other campus educators to develop expertise in assessment of student learning, related practices; explicit, positive role in reward structure</td>
<td>Significant support for faculty, other campus educators to develop expertise in assessment of student learning, related practices; explicit, prominent role in reward structure</td>
<td></td>
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<tr>
<td><strong>Organizational Learning</strong></td>
<td>Notable by their absence or considered only sporadically in decision-making</td>
<td>Found in some areas; dissemination of performance results just beginning; no reference to comparative data</td>
<td>Multiple, with data collected regularly, disseminated, collectively analyzed; some comparative data used. Some indicators used to inform planning, budgeting, other decision making on occasional basis</td>
<td>Multiple, with data collected regularly, disseminated widely, collectively analyzed; comparative data used, as appropriate, in all programs. Indicators consistently used to inform planning, budgeting, other decision making at all levels of the institution</td>
<td></td>
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<tr>
<td><strong>B. Formal program review (CFRs 2.7, 4.4) is:</strong></td>
<td>Rare, if it occurs at all, with little or no useful data generated. Assessment findings on student learning not available and/or not used</td>
<td>Occasional, in some departments or units; heavy reliance on traditional inputs as indicators of quality; findings occasion ally used to suggest improvements in educational effectiveness; weak linkage to institution-level planning, budgeting</td>
<td>Frequent, affecting most academic and co-curricular units, with growing inclusion of findings about student learning; unit uses findings to collectively reflect on, improve effectiveness; some linkage to institution-level planning, budgeting</td>
<td>Systematic and institution-wide, with learning assessment findings a major component; units use findings to improve student learning, program effectiveness, and supporting processes; close linkage to institution-level planning, budgeting</td>
<td></td>
</tr>
<tr>
<td><strong>C. Performance data, evidence, and analyses (CFRs 4.3, 4.5, 4.6) are:</strong></td>
<td>Not collected, disseminated, disaggregated, or accessible for wide use. Not evident in decision-making processes; do not appear to be used for improvement in any programs</td>
<td>Limited collection, dissemination, disaggregation, or access. Campus at beginning stages of use for decisions to improve educational effectiveness at program, unit, and/or institutional level</td>
<td>Systematic collection and dissemination, wide access; sometimes disaggregated; usually considered by decision-making bodies at all levels, but documentation and/or linkage to educational effectiveness may be weak</td>
<td>Systematic collection and dissemination, and access, purposeful disaggregation; consistently used by decision-making bodies for program improvement at all levels, with processes fully documented</td>
<td></td>
</tr>
<tr>
<td><strong>D. Culture of inquiry and evidence (CFRs 4.5, 4.6, 4.7):</strong></td>
<td>Faculty, other educators, staff, institutional leaders, governing board not visibly committed to a culture of inquiry and evidence except in isolated cases; not knowledgeable about learner-centeredness, assessment, etc.</td>
<td>Campus knowledge is minimal; support – at top levels and/or grass roots – for development of a culture of inquiry and evidence is sporadic and uneven</td>
<td>Campus knowledge and support for a culture of inquiry and evidence fairly consistent across administration, faculty, professional staff but may not be uniformly deep</td>
<td>Consistent, knowledgeable, deep commitment to creating and sustaining a culture of inquiry and evidence in all appropriate functions at all levels</td>
<td></td>
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<tr>
<td><strong>E. Communication and transparency (CFR 1.2, 1.7):</strong></td>
<td>Little or no data, findings, analyses from assessment of student learning available within the institution or to external audiences</td>
<td>Some data, findings, analyses from assessment of student learning available but may be incomplete, difficult to access or understand for internal or external audiences</td>
<td>Data, findings, analyses from assessment of student learning generally available, easily accessible; chosen for relevance to multiple audiences</td>
<td>Data, findings, analyses from learning assessment are widely available and skillfully framed to be understandable, useful to multiple audiences</td>
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<tr>
<td><strong>Overall: The institution can best be described as:</strong></td>
<td>Committed to isolated aspects of educational effectiveness; if other areas are not addressed, continuing reaffirmation of accreditation is threatened</td>
<td>Committed to educational effectiveness in some areas; significant number of areas require attention, improvement</td>
<td>Mostly well-established commitment to educational effectiveness; a few areas require attention, improvement</td>
<td>Fully committed to and going beyond WASC recommendations; operates at an exemplary level in addressing its Core Commitments to capacity as it relates to learning and to educational effectiveness</td>
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GUIDELINES FOR ASSESSMENT AND ACCOUNTABILITY IN HIGHER EDUCATION

1 Set Ambitious Goals

There is general agreement about the desired outcomes of undergraduate education. This broad consensus includes the development of appropriate levels of knowledge and skills; the ability to integrate and apply knowledge to a variety of problems; and the acquisition of intellectual and social habits and dispositions in preparation for productive, responsible citizenship. Learning goals may vary according to an institution’s mission, resources, student population, and community setting, but they typically include acquiring both broad learning and specialized knowledge; developing intellectual and practical skills; developing a sense of personal and social responsibility; and integrating and applying learning.

Each college and university is encouraged to articulate its specific goals for student learning and prominently announce these goals to various stakeholders and the public. Similarly, the major academic divisions and cocurricular departments within an institution are encouraged to state their goals and their connection to the broader institutional aims and the constituencies they seek to serve. Faculty members, staff, and administrators should understand the relationship of their work to these learning goals. Students should also understand and be able to articulate the relationship of their coursework and cocurricular experiences to the learning goals.
IS YOUR INSTITUTION SETTING AMBITIOUS GOALS?

Colleges and universities and their major programs can use the following guidelines to determine the degree to which they are setting ambitious goals:

- The institution’s statements of learning outcomes clearly articulate what students should be able to do, achieve, demonstrate, or know upon the completion of each undergraduate degree.

- The outcomes reflect appropriate higher education goals and are stated in a way that allows levels of achievement to be assessed against an externally informed or benchmarked level of achievement or assessed and compared with those of similar institutions.

- Institutional practices, such as program review, are in place to ensure that curricular and cocurricular goals are aligned with intended learning outcomes.

- The institution and its major academic and cocurricular programs can identify places in the curriculum or cocurriculum where students encounter or are expected or required to achieve the stated outcomes.

- Learning outcome statements are presented in prominent locations and in ways that are easily understood by interested audiences.

Gather Evidence of Student Learning

SYSTEMATIC PROCESSES FOR GATHERING EVIDENCE allow colleges and universities to discover how well students are progressing toward the institution’s overall and programmatic learning outcomes. Evidence-gathering efforts that are ongoing, sustainable, and integrated into the work of faculty and staff can suggest where the institution is succeeding and where improvement is needed.

Gathering evidence concerning the degree to which students are actively engaged in academically challenging work can also suggest ways in which student learning can be enhanced. There are significant differences within colleges and universities in the degree of academic engagement among students. Similarly, disaggregation and comparison of results by gender, race/ethnicity, and other variables...
permit an institution to monitor educational equity. Evidence of how well students are achieving learning outcomes (i.e., “What is good enough?”) against externally informed or benchmarked assessments or against similar colleges and universities, where appropriate and possible, provides useful comparisons. At the same time, it is critical to keep in mind that the objective of comparison is not ranking but improvement.

**IS YOUR INSTITUTION GATHERING EVIDENCE OF STUDENT LEARNING?**

Colleges and universities and their major programs can use the following guidelines to determine how effectively they are gathering evidence of student learning:

- Policies and procedures are in place that describe when, how, and how frequently learning outcomes will be assessed.
- Assessment processes are ongoing, sustainable, and integrated into the work of faculty, administrators, and staff.
- Evidence includes results that can be assessed against an externally informed or benchmarked level of achievement or compared with those of other institutions and programs.
- Evidence also includes assessments of levels of engagement in academically challenging work and active learning practices.
- Results can be used to examine differences in performance among significant subgroups of students, such as minority group, first-generation, and non-traditional-age students.

**Use Evidence to Improve Student Learning**

THE PURPOSE OF GATHERING EVIDENCE OF STUDENT LEARNING is to use it to ensure quality in student learning and to improve it. Using evidence effectively requires a plan that makes the analysis and use of evidence a prominent and consequential factor in the institution’s strategic planning and program review processes. Discussions about evidence can lead to recommendations for institutional improvement and taking action when appropriate and feasible. The cycle of making evidence-based changes in programs and practices promotes continuous review, evaluation, and reporting of institutional action and improvement.
IS YOUR INSTITUTION USING EVIDENCE TO IMPROVE STUDENT LEARNING?

Colleges and universities and their major programs can use the following guidelines to determine how effectively they are using evidence to improve student learning:

- Well-articulated policies and procedures are in place for using evidence to improve student learning at appropriate levels of the institution.

- Evidence is used to make recommendations for improvement of academic and cocurricular programs.

- There is an established process for discussing and analyzing these recommendations and moving from recommendation to action. Where feasible and appropriate, key recommendations for improvement are implemented.

- The impact of evidence-based changes in programs and practices is continuously reviewed and evaluated.

Report Evidence and Results

REPORTING EVIDENCE AND RESULTS OF STUDENT LEARNING to both internal and external constituents strengthens the institution’s commitment to improving programs and services that contribute to a high level of student accomplishment. Assessments of student learning can be shared with internal constituents (e.g., faculty members, staff, administrators, students) in a variety of ways, including through regularly scheduled and well-publicized meetings, which can lead to changes in program and pedagogy. The institution’s governing board should receive regular reports about the assessment of student learning and efforts to use evidence to improve programs. In addition, the institution can ensure transparency and accountability to the public by developing on its website a highly visible and easily accessible location that highlights evidence of student learning, its use, and other institutional indicators (e.g., retention rates, time to degree).

In recent years, significant steps have been taken toward greater transparency in reporting results for students. Associations representing both public and private institutions have developed reporting templates that provide important information about
institutional demographics, persistence, and completion, as well as information about student experience and learning outcomes. Such templates aid understanding by using uniform definitions and reporting conventions. Colleges and universities should evaluate such templates and use them to support internal discussion and communication to the public.

**IS YOUR INSTITUTION REPORTING EVIDENCE AND RESULTS?**

Colleges and universities and their major programs can use the following guidelines to determine how effectively they are reporting evidence and results:

- Regular procedures are in place for sharing evidence of student learning with internal and external constituencies.

- Internal reporting includes regularly scheduled meetings, publications, and other mechanisms that are accessible to all relevant constituencies (e.g., faculty, staff, administrators, students, the governing body).

- Reporting to external constituencies via the institutional website includes evidence of learning as well as additional descriptive information and indicators of institutional performance (e.g., retention rates, time to degree).

- Reporting on student learning outcomes is both accessible to and appropriate for the relevant audience.

- The results of evidence-based changes in programs and practices are reported to appropriate internal and external constituencies.
The 5 Imperatives of Teacher Education®
Assessing Innovation and Quality Design in Science and Mathematics Teacher Preparation
Authored by
Charles R. Coble with Lizanne DeStefano, Nancy Shapiro, Jennifer Frank, Michael Allen, Gary Martin and Marilyn Strutchens

Science and Mathematics Teacher Imperative (SMTI)
Association of Public and Land-grant Universities

The 5 Imperatives of Teacher Education and the 5I Assessment were created to fill a void – the lack of a common framing tool for use in analyzing, designing and implementing more coherent, engaging and effective science and mathematics teacher education programs. In developing the tool the authors, with funding from APLU, the Carnegie Corporation and from the National Science Foundation, have sought out the advice and critique from dozens of P-20 experts, opinion leaders individually and in focus groups across the nation. Essential to the development of the 5 Imperatives model and the 5I Assessment has been site visits and field-tests in ‘traditional’ and ‘non-traditional’ settings. The 5I Assessment is a dynamic tool that continues to evolve as additional insights are gained from users, researchers and critics of the strategies included within the framework. While the 5I Assessment will never fully describe all that occurs in the hundreds of science and mathematics teacher education programs across the nation, it can hopefully serve as a common structure for identifying and making known strategies that may be helpful as educators work to create the most effective preparation programs possible.

The 5I Assessment can be used: (a) to help identify desirable, feasible and comparable strategies across institutions; (b) as a common structure for identifying effective science and mathematics teacher education practices and making those strategies known to others; and (c) to celebrate differences among programs by showing how different but equally valid strategies can contribute toward the same goals and objectives. The 5I Assessment is intended to help educators and policymakers to both better understand the complexity of science and mathematics teacher education and to be useful in identifying desirable practices that can be employed to build programs that are not only more coherent and effective, but more interesting and intellectually challenging for faculty and teacher candidates.

The 5I Assessment is structured around five imperatives for teacher preparation, which stretch the traditional, and limiting, conceptions of teacher education beyond the generally perceived boundaries of pre-service preparation. Each of the imperatives contributes, in essential ways, to the development of more reliably effective teachers of science and mathematics.

- **Imperative 1. Leadership, Policy and Infrastructure.** Thoughtful leadership is critical to help form institutional, local, state and federal policies that support the preparation of science and mathematics teachers.
- **Imperative 2. Recruitment, Selection and Admission.** Significant care must be given to recruiting, selecting and admitting candidates with the demonstrated passion and potential for teaching and for working collaboratively to advance student learning.
- **Imperative 3. Content, Pedagogy and Clinical Practice.** Teacher candidates’ must master their discipline and the pedagogical knowledge necessary for integrating science and mathematics content into well-structured lessons for P-12 students in authentic school settings.
- **Imperative 4. Beginning Teacher Support.** The success of science and mathematics teacher candidates is not assured on
graduation day; disciplinary and pedagogical faculties must extend support to program completers as beginning teachers.

- **Imperative 5. Teacher and School Development.** Partnership schools must be supported to model the practices and high expectations for students that inspire and instruct prospective teachers of science and mathematics.

**Four crosscutting design features** permeate the 5I Assessment:

- **First, teacher education must be an “all-campus” responsibility.** Science and mathematics faculty must insure that teacher students have a comprehensive understanding of science and mathematical concepts and theories. Science and mathematics faculty should also collaborate with pedagogical faculty who must assure that pre-service teachers learn how to teach science and mathematics effectively to students with different preconceptions and levels of understanding. Campus leaders must foster policies that support collaboration for effective science and mathematics teacher preparation.

- **Second, teacher education must be clinically based, requiring close links with P-12 schools.** Deep and sustained partnerships between higher education and the P-12 schools are focused on creating and sustaining a culture of collaboration, which is foundational for preparing effective teachers of science and mathematics.

- **Third, teacher education must be focused on reliably preparing beginning teachers who can advance student achievement.** The end-goal of positively impacting P-12 student success must be kept clearly in mind; all science and mathematics teacher education graduates must demonstrate the passion and ability to work collaboratively in professional learning communities to advance student learning for all.

- **Fourth, teacher education must fully embrace digital technology and communications strategies to be made more efficient and effective.** Accessing digital content, using social media and applying other technologies appropriately to teaching and learning are now essential skills for teachers and teacher candidates to master.

**Purpose of the 5I Assessment:** To assess and analyze policies and practices related to the recruitment, preparation, induction and development of science and mathematics teachers.

**Program Improvement:** The 5I Assessment provides an easily administered structure for analyzing and reflecting on perceived strengths and areas of needed improvement within and across science-mathematics preparation programs. The 5I Assessment is particularly useful in assessing program alignment to the Common Core State Standards and the NRC Science Framework. Because science and mathematics teacher preparation is nested within the larger milieu and policy context in which teacher preparation exist, that is reflected in the structure of goals, objectives and strategies within the 5I Assessment.

The 5I Assessment was designed with the understanding that no one person possesses all of the knowledge about a program; people involved in the same program can have different perceptions about the same program. Thus, the developers of the 5I Assessment strongly suggest that people with different roles and responsibilities (including P-12 partners) associated with a program complete the assessment and use the individual and summative responses as data for seeking consensus about what is valued and what is implemented in a program and as data for mapping program improvement strategies.

**Promising Practices:** The 5I Assessment can also be used to help identify and achieve consensus around one or more of the Framework’s core competencies, goals, objectives or strategies that may be particularly noteworthy and nominated for consideration as a Promising Practice by APLU. Institutions that submit strategies/practices for consideration as a Promising Practice will be requested to provide documentation and evidence of the impact or success of the practice. Panels of experts,
who may request additional information, will review nominations submitted to APLU. If selected, institutions will have the program posted on the APLU/SMTI website.

**Note:** The online 5I Assessment survey requires approximately 60 minutes to complete in its entirety. Results can be made available individually and summarized across all respondents for use in helping achieve consensus on program strengths and areas of needed improvement.

Authors: Charles R. Coble with Lizanne DeStefano, Nancy Shapiro, Jennifer Frank, Michael Allen, Gary Martin and Marilyn Strutchens

The 5 Imperatives of Teacher Education and 5I Assessment have been developed with the tireless enthusiasm, prodding and active engagement of Howard Gobstein, Executive Vice President, Research, Innovation, and STEM Education, APLU.

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**Advisory Committee for the Analytic Framework:** Deborah L. Ball, Dean, School of Education, University of Michigan; Cynthia Bauerle, Senior Program Officer, PreCollege and Undergraduate Science Education, Howard Hughes Medical Institute; Carlos Contreras, US Education Director, Intel Corporation; Daniel Goroff, Program Director, Alfred P. Sloan Foundation; David Imig, Professor of the Practice, College of Education, University of Maryland; Jim Lewis, Professor of Mathematics, University of Nebraska-Lincoln; Deborah Lowe Vandell, Professor and Chair, Department of Education, University of California, Irvine; Lynne Weisenbach, Vice Chancellor for Educator Preparation and Innovation, Board of Regents of the University System of Georgia; Stamatis Vokos, Professor of Physics, Seattle Pacific University; Suzanne Wilson, Chair Department of Teacher Education, College of Education, Michigan State University.
The 5I Assessment
Assessing Innovation and Quality Design in Science and Mathematics Teacher Preparation
v.2.5.12
Support provided by the Association of Public and Land-grant Universities (APLU), the Carnegie Corporation and the National Science Foundation

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Institution: ____________________________________________________________

Provide a brief title/description of program being assessed (such as B.A./B.S. Science or Mathematics Degree with teacher licensure option; M.A.T. in Secondary Science or Mathematics; Mid-Career Math Prep Program, etc.):

Institutional or Program Profile (Please provide 1-3 sentences that provide context for your survey responses, such as mission, particular demographic focus, rural or urban serving, etc.):

__________________________________________________________________________________________________________________________________________________________________________________________________________

Respondent (check primary role): ___University President/Chancellor; ___Provost or Assoc. or Asst. Provost; ___Dean or Assoc. or Asst. Dean of Education; ___Dean or Assoc. or Asst. Dean of Arts & Sciences; ___Dept. Chair (list department)_____________; ___Director of Teacher Education; ___Faculty(unit affiliation)_____________________; ___School administrator; ___Partnership administrator/staff; ___Cooperating Teacher/Clinical faculty; ___Current/former student; ___Other (describe)___________________.

Should be a valued component of a science or mathematics teacher preparation program at any institution or partnership.
U = Uncertain
1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree

Is an effectively implemented component in the science or mathematics teacher preparation program in our institution or partnership.
U = Uncertain
1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree
<table>
<thead>
<tr>
<th>Imperative</th>
<th>Policy and Infrastructure</th>
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<tr>
<td><strong>Goal:</strong> Promote and Sustain a Strong Institutional Commitment to the Preparation and Development of Highly Capable Teachers in Science and Mathematics</td>
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<tr>
<td><strong>Objective I.A:</strong> The Institutional Infrastructure Promotes Shared Responsibility and Accountability for Science and Mathematics Teacher Preparation within the Institution and with P-12 Schools and the Community</td>
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<tr>
<th>Strategies</th>
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<tbody>
<tr>
<td>1. <strong>Policy &amp; Practice:</strong> Institutional policies and practices, including financial allocations, are aligned to strengthen clinically based science-mathematics teacher preparation and development at the institution (e.g., mission, visibility, funding).</td>
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<tr>
<td>2. <strong>Internal Collaboration:</strong> The institution and/or science-mathematics preparation programs have identified the needs and opportunities for internal collaboration among education, science-mathematics departments, and/or other professional schools, regarding teacher preparation and development and have made significant progress toward establishing those collaborations.</td>
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<td>3. <strong>Boundary Crossers:</strong> Interdisciplinary &quot;boundary crossers&quot; between education and science-mathematics departments and between university and P-12 faculty have positively contributed to the program’s success (e.g., joint faculty appointments, collaboration on research and teaching, joint projects, etc.).</td>
</tr>
<tr>
<td>4. <strong>Special Organizational Structures:</strong> The institution and/or academic units have created special institutes, offices, or departments that have contributed to the success of science-mathematics teacher preparation and development programs.</td>
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<tr>
<td>5. <strong>Accountability Infrastructure:</strong> The institution has an infrastructure of people and technology that promotes comprehensive program assessment and accountability for candidate quality from entry to exit and into the beginning years of teaching with evidence of impact on P-12 student outcomes in science-mathematics.</td>
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### Imperatives, Goals, Objectives and Strategies


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<tr>
<th>Strategies</th>
<th>Value Assessment</th>
<th>Implementation Assessment</th>
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<tr>
<td>1. Roles &amp; Responsibilities: Clear roles and responsibilities have been established for science-mathematics and education faculty, as well as affiliate faculty from P-12 partnership schools, regarding their involvement in teacher preparation, including roles and responsibilities for clinical faculty.</td>
<td>U1 2 3 4</td>
<td>U1 2 3 4</td>
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<tr>
<td>2. Promotion &amp; Tenure: Faculty appointment, promotion, and tenure policies encourage science-mathematics faculty and education faculty involvement in science-mathematics teacher preparation and professional advancement programs (including research leading to improved programs and practices). *</td>
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<tr>
<td>3. Incentives &amp; Rewards: Incentives and rewards (beyond tenure and promotion) are used successfully to encourage increased science-mathematics and education faculty engagement in teacher preparation, mentoring beginning teachers, and in professional advancement programs for inservice teachers of science-mathematics, particularly those in partnership schools. *</td>
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<tr>
<td>4. Improving Courses &amp; Teaching: The institution and academic units encourage science-mathematics faculty and other disciplinary faculty, through faculty appointment policies, promotion and tenure policies, and other incentives and rewards, to improve teaching, learning and student assessments.</td>
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<tr>
<td>5. Professional Engagement: The institution and/or science-mathematics teacher preparation programs encourage faculty to be professionally active with local, state, regional, and national associations, committees, and university-school partnerships as a strategy for promoting effective science-mathematics teacher education and development.</td>
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</table>

**Objective I.C The Institution and/or Program Pursues Partnerships and External Financial and Policy Support for Science-Mathematics Teacher Preparation and Development**

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Value Assessment</th>
<th>Implementation Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Partnerships with PK-12 Schools, Business and Community: Institutional and program policies and practices support formal external partnerships as an essential strategy for assessing needs and designing and delivering student/problems-centered science-mathematics teacher preparation and development programs.</td>
<td></td>
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<tr>
<td>2. External Funding: The institution is successful in securing external funding (e.g., state and federal grants, private foundation support) to address identified needs for science-mathematics teacher preparation and development.</td>
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</tr>
<tr>
<td>3. External Advocacy: Campus administration and/or faculty are active in advocating for policy changes (local, state, national) to strengthen university-school partnerships and clinical preparation, scholarships and other incentives for high performing and diverse science-mathematics teacher candidates, support for program completers, and professional advancement programs for inservice teachers of science-mathematics.</td>
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</tbody>
</table>
### Imperative II: Recruitment, Selection and Admission

**Goal:** Recruit High Quality and Diverse Candidates into Science and Mathematics Teacher Preparation

**Objective II.A Institutional and/or Program Policies and Practice Ensure that Science and Mathematics Teacher Preparation Is Highly Selective, Admitting Teacher Candidates With Demonstrated Academic Skills and Genuine Interest in K-12 Science or Mathematics Teaching**

<table>
<thead>
<tr>
<th>Strategies</th>
</tr>
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<tbody>
<tr>
<td><strong>1. Recruit Accomplished Candidates:</strong> The science and mathematics teacher preparation programs have developed practices and procedures to actively screen and recruit teacher candidates who are not only academically accomplished, but also demonstrate passion, persistence, high expectations and success in working with learners and exhibit other characteristics that align with program expectations. *</td>
</tr>
<tr>
<td><strong>2. Recruit Candidates from Multiple Sources:</strong> The science and mathematics teacher preparation programs are resourceful in recruiting talented teacher candidates from a variety of sources such as: high school students; community college students; currently enrolled university students; mid-career adults, including teacher paraprofessionals; military retirees; and/or retirees from STEM-related businesses and industries.</td>
</tr>
<tr>
<td><strong>3. Enforce High Program Admission Standards:</strong> The institution and science and mathematics teacher preparation programs have set standards for program admission that require candidates, without exception, to demonstrate strong performance in college coursework, especially in science-mathematics content areas.</td>
</tr>
</tbody>
</table>
### Objective II.B The Teacher Education Program has Developed and Sustained an Infrastructure to Recruit and Retain Teacher Candidates Matched to Assessed Needs for Science and Mathematics Teachers in the Region or State

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Value Assessment</th>
<th>Implementation Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assess Local Needs: The science and mathematics teacher preparation programs have data on the needs for science and mathematics teachers (quantity, quality and diversity) in the region and districts most served by the institution.</td>
<td>U1 2 3 4</td>
<td>U1 2 3 4</td>
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<tr>
<td>2. Respond to Local Needs: The institution, academic units and teacher preparation programs have made a quantifiable commitment to help meet the identified needs for new and/or stronger teachers of science-mathematics in the region and districts most served by the institution.</td>
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<tr>
<td>3. Funding Recruitment: Funds are available to support the recruitment of science-mathematics teacher candidates.</td>
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<tr>
<td>4. Financial Incentives for Students: Financial incentives are in place to support students recruited to prepare for science-mathematics teaching.</td>
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<tr>
<td>5. Track Student Success: The science and mathematics teacher preparation programs monitor the progress of all teacher candidates, from multiple pathways: high school students; community college students; currently enrolled university students; mid-career adults; paraprofessionals; and military and other retirees) and from underserved populations (Native Americans, Hispanics, African Americans, and others) through the academic pipeline from recruitment to program completion to beginning teaching.</td>
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</table>

### Objective II.C The Teacher Education Program Actively Recruits Diverse and Underserved Populations into Science and Mathematics Teacher Preparation

<table>
<thead>
<tr>
<th>Strategies</th>
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</thead>
<tbody>
<tr>
<td>1. Commitment to Diversity: The science and mathematics teacher preparation programs demonstrate a commitment to recruit highly able teacher candidates from diverse and underserved populations into science-mathematics teaching.</td>
<td></td>
</tr>
<tr>
<td>2. Strong Minority Student Support: The science and mathematics teacher preparation programs provide strong mentoring and peer support for minority students enrolled in their programs.</td>
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</tbody>
</table>
### Imperative III: Content, Pedagogy, and Clinical Practice

**Goal:** Prepare Quality Teachers with Demonstrated Capability to Improve Student Success in Science and Mathematics

**Objective III.A The Teacher Preparation Program Ensures that Teacher Candidates Have the Knowledge and Understanding of Science and Mathematics to Promote Student Success**

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Value Assessment</th>
<th>Implementation Assessment</th>
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<tbody>
<tr>
<td><strong>1. Deep Disciplinary Knowledge.</strong> The science and mathematics teacher preparation programs ensure that teacher candidates have a solid understanding of science-mathematics as disciplines.*</td>
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<tr>
<td><strong>2. Knowledge for Teaching:</strong> The science and mathematics teacher preparation programs ensure that teacher candidates possess the science-mathematical knowledge, skills and dispositions necessary for teaching the secondary science-mathematics curriculum, including the conceptual areas embedded within the NRC Science Framework, the Common Core State Standards and the Standards of Mathematical Practice.*</td>
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<tr>
<td><strong>3. Students and Disciplinary Research:</strong> The science and mathematics teacher education programs, particularly the science-mathematics departments, offer opportunities for teacher candidates and others to engage in inquiry and research in the science-mathematics disciplines.</td>
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<tr>
<td><strong>4. Students Are Well Supported:</strong> The science and mathematics teacher preparation programs, particularly the academic departments, provide academic support whether through faculty availability, student tutors, peer support, online services or other resources to ensure that teacher candidates possess the necessary background in science-mathematics content to improve student success in science-mathematics.</td>
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<tr>
<td><strong>5. Teaching/Learning Assistant Opportunities:</strong> The science and mathematics teacher preparation programs, particularly the science and mathematics departments, offer opportunities for students to learn and demonstrate their ability to work as teaching/learning assistants or tutors to other students.</td>
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</tbody>
</table>
### Objective III.B The Teacher Preparation Program Ensures Students Have the Education and Preparation to Improve Student Success in Science and Mathematics

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Value Assessment</th>
<th>Implementation Assessment</th>
</tr>
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<tbody>
<tr>
<td>1. Lesson Design: The teacher preparation programs ensure that teacher candidates can design coherent, scaffolded classroom curricula and content-rich, developmentally appropriate, and engaging science or mathematics lessons.*</td>
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<tr>
<td>2. Differentiation of Instruction: The teacher preparation programs ensure that teacher candidates are able to understand students’ knowledge of science-mathematics and design instruction using different instructional strategies that actively engages, motivates and meets the needs of the full range of students with different preconceptions and levels of understanding in their classes.*</td>
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<tr>
<td>3. Managing Discourse. The teacher preparation programs ensure that teacher candidates are able to facilitate productive science-mathematical discourse within a classroom to promote student engagement, understanding and motivation to learn.*</td>
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<tr>
<td>4. Attention to Diversity. The science and mathematics teacher preparation programs ensure that teacher candidates understand, acknowledge and engage the unique contributions of all students in their classes – including low-performing students; gifted students; students of different racial, sociolinguistic, and socioeconomic status; and students with disabilities – and maintain high expectations for all students.</td>
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<tr>
<td>5. Assessment Use and Design: The science and mathematics teacher preparation programs ensure that teacher candidates can design assessments for entry-level knowledge and assess on-going learning of students using both formative and summative assessments, and use data from these assessments to better assure access and equity to science-mathematical knowledge to all students.*</td>
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<tr>
<td>6. Instructional Technology: The science and mathematics teacher preparation programs ensure that teacher candidates are able to demonstrate their ability to access digital content, using social media and applying other technologies (dynamic geometry environments, CAS, spreadsheets, graphic calculators, etc.) to increase the efficiency and effectiveness of science-mathematics teaching and learning.</td>
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<tr>
<td>7. Research on Teaching and Learning. The science and mathematics teacher preparation programs ensure that teacher candidates are able to collaborate with others in designing and conducting classroom-based action research on science-mathematics teaching and learning.</td>
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<tr>
<td></td>
<td>The science and mathematics teacher preparation programs provide teacher candidates with early, sequential and increasingly intensive clinical experience in both laboratory settings and embedded experiences in partnership schools, in which they:</td>
<td>The science and mathematics teacher preparation programs provide teacher candidates with early and continuing field placements and guided supervision in partnering schools that are experiencing success with historically diverse populations and (previously) low performing in science-mathematics, and where candidates learn and demonstrate their comfort and capacity to work in schools and communities with high numbers of minority and at-risk learners.</td>
</tr>
<tr>
<td>Imperatives, Goals, Objectives and Strategies</td>
<td>Value Assessment</td>
<td>Implementation Assessment</td>
</tr>
<tr>
<td>---------------------------------------------</td>
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<td>--------------------------</td>
</tr>
<tr>
<td>Objective III.D The Science and Mathematics Teacher Preparation Program Ensures Coherence and Alignment with Local and State Education Policies and National and International Science and Mathematics Standards and for Producing Teacher Candidates who Demonstrate the Capacity to Teach to High Standards</td>
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</table>

1. **Coherent and Efficient Design**: The science and mathematics teacher preparation programs are a coherently designed sequence of science-mathematics content courses, pedagogical courses (child/adolescent development, student motivation and learning, social behavior and classroom management, questioning strategies, content methods, teaming, etc.) and mentored clinical/field experiences (primarily within partnership schools) that produce verifiably effective beginning teachers of science or mathematics.*

2. **Frequent Teacher Candidate Screening Practices**: The science and mathematics teacher preparation programs ensure that teacher candidates can demonstrate through practices and instruments (developed with the input of P-12 educators) that they are on track toward acquisition of the knowledge, skills and dispositions necessary to work with colleagues and teach science-mathematics effectively to a wide range of diverse learners.

3. **Aligned with State & District Curricula**: The science and mathematics teacher preparation programs ensure that teacher candidates are familiar with and can design and teach lessons aligned to the science and mathematics curricula used in the state, district and partnerships schools where they have clinical and field placements.

4. **Aligned with K-12 Standards**: The science and mathematics teacher preparation programs ensure that teacher candidates can incorporate the NRC Science Framework, CCSS and the Standards of Mathematical Practice into the design and delivery of science-mathematics instruction.

5. **Aligned with National and International Assessments**: Both the disciplinary and pedagogical components of the science and mathematics teacher preparation programs ensure that teacher candidates have mastered the knowledge and critical thinking skills necessary to perform well themselves and to help their students perform well on NAEP, TIMSS, PISA, and other national and international science and mathematics assessments.

6. **Aligned with Teacher Preparation Standards**: The science and mathematics teacher preparation programs’ assessments of teacher candidates’ knowledge, skills and dispositions are used as essential evidence supporting claims of program effectiveness and that the programs meet standards for best practice in science and mathematics teacher preparation.
### Imperative IV: Beginning Teacher Support

**Goal:** Support and Learn from Program Completers as Beginning Science and Mathematics Teachers

**Objective IV.A The Science and Mathematics Teacher Preparation Program Tracks and Assesses the Effectiveness of Program Completers and Beginning Teachers**

<table>
<thead>
<tr>
<th>Strategies</th>
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<tbody>
<tr>
<td><strong>1. Collecting and Using Beginning Teacher Data:</strong> The science and mathematics teacher preparation programs have established a feedback loop that seeks input from program completers and from their principals and mentors as well, using the information to both better respond to the needs of beginning science and mathematics teachers and as data for improving the teacher preparation programs.</td>
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<tr>
<td><strong>2. Tracking Retention &amp; Effectiveness:</strong> The science and mathematics teacher preparation programs, in cooperation with local or state agencies, track the employment, retention, and effectiveness (including, if possible, student achievement data) of program completers.</td>
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</table>

**Objective IV.B The Teacher Preparation Program Provides Mentoring and Support Mechanisms for Recent Science and Mathematics Program Completers**

<table>
<thead>
<tr>
<th>Strategies</th>
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<tbody>
<tr>
<td><strong>1. Beginning Teachers Seek Support:</strong> The teacher preparation program completers in science and mathematics have been prepared to be active in seeking out on-line and face-to-face support from experienced teachers, peers and from professional associations and demonstrate that ability in their beginning years of teaching.</td>
<td></td>
</tr>
<tr>
<td><strong>2. Extending Support to Beginning Teachers:</strong> The science and mathematics teacher preparation programs aggressively seek out and extend support (including both disciplinary and education faculty) on-line and face-to-face to program completers, in cooperation with P-12 schools, for one to three years.</td>
<td></td>
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</table>
### Imperative V: Teacher and School Development

**Goal:** Provide Continuing Learning Opportunities and Advanced Studies for In Service Science and Mathematics Teachers

**Objective V.A The Science-Mathematics Teacher Education Program Partners with Schools and Community to Assess, Plan and Implement Professional Advancement Options for Science and Mathematics Teachers**

#### Strategies

1. **Partnerships with P-12 School & Districts:** Structures (such as consortia, alliances, P-20 councils, partnerships, or other mechanisms) exist to engage P-12 science and mathematics educators in the collaborative design and delivery of professional development, advanced studies and provide teacher leadership opportunities, especially teachers who support pre-service candidates' clinical and field experiences. *

2. **Build Communities of Practice:** Advanced studies and professional development are designed to build science and mathematics teachers’ academic and pedagogical content knowledge and skills as well as the leadership skills of teachers in a community of practice that supports faculty and teachers as well as program improvement in both the schools and college/university.

3. **Aligned with Standards:** The scope and sequence of the institution’s professional development program is aligned with district, state and the NRC Science Framework or Common Core State Standards-Mathematics.

4. **Online Extended Access:** Advanced studies and professional advancement programs in science-mathematics are increasingly available online or in “blended” models of instruction.

5. **Research or Work-Learn Experiences:** The teacher preparation programs, particularly the science-mathematics departments, extend opportunities to involve teachers of science-mathematics in authentic research with disciplinary faculty and/or engage in discipline-related summer employment opportunities, on or off campus.

**Objective V.B The Science-Mathematics Teacher Education Program Promotes and Sustains Professional Development Programs for Graduates and Other Science and Mathematics Teachers**

#### Strategies

1. **Leadership and Policy:** The institution and teacher preparation programs place a priority on extending the human and material capacity of the university to support the continuing development of science and mathematics teachers and the improvement of P-12 education, particularly cooperating teachers in partnership schools, as a strategy for improving the clinical preparation of teacher candidates.

2. **Assessment and Program Improvement:** The teacher preparation programs use teacher and employer surveys to assess the impact of professional development and advanced study programs in science and mathematics and uses the data for continuous program improvement.*

* = Proposed Key Indicators
CORE COMMITMENTS:
Educating Students for Personal and Social Responsibility

Ten Markers of Campus Culture*

1. Mission and Educational Purpose
   a) clarity concerning the dimensions as an important aspect of the institution’s comprehensive educational mission
   b) college catalog
   c) policy statements/handbooks (such as honor codes)
   d) educational programming/orientation concerning the dimensions for students, faculty, and staff
   e) public communications (web sites, public letters, press releases, official publications)

2. Institutional Leadership and Advocacy
   a) statements/official communications by campus leaders
   b) clarity concerning the dimensions as goals and outcomes of a college education
   c) degree of community awareness of the dimensions as educational outcomes
   d) comprehensiveness of scope of the dimensions across multiple aspects of the campus culture
   e) congruence of reward systems for the dimensions

3. Policies and Procedures
   a) existence of public policies and procedures for students, faculty, and staff
   b) consistencies of education and enforcement of policies and procedures (such as academic honor codes and student codes of conduct)
   c) attention to diversity and equity for community members
   d) congruence of reward system for development along the dimensions
   e) an integration of expectations of development along all five dimensions across academic and student affairs

4. Expectations for Competency and Growth
   a) regular and consistent systems of feedback
   b) ongoing evaluation and assessment
   c) opportunities for reflection and demonstration of competency
   d) education about and clarity of expectations in multiple aspects of campus life
   e) reward systems consistent with competency and growth

5. Campus Activities and Organizations
   a) civic engagement as a regular aspect of campus life
   b) diversity and equity training and membership in organizations
   c) expectation of civil behavior
   d) emphasis on active learning, reflection, and feedback
   e) diverse opportunities for leadership and growth

6. Scholarly Activities
   a) teaching and learning related to the five dimensions
   b) opportunities to apply knowledge in practical ways
   c) research related to the dimensions
   d) assignments/tasks that: require development of competency in the dimensions
   e) reward and reinforcement for scholarly work that relates to the dimensions

Core Commitments is supported by a generous grant from the John Templeton Foundation.
CORE COMMITMENTS:
Educating Students for Personal and Social Responsibility

7. Curriculum and Pedagogy
   a) diversity in ways of teaching and learning (pedagogies of engagement and integration)
   b) clear expectations and requirements for excellence and integrative work
   c) wide range of intellectual opportunities in courses, programs, majors
   d) systematic feedback about progress in intellectual and ethical development
   e) expectations of personal and academic integrity

8. Campus-Community Involvement
   a) ongoing, collaborative projects and programs between community and campus leaders
   b) recognition of scholarship and pedagogy that focus on the community
   c) community-based projects and programs have ongoing assessment and feedback for student learning
   d) community leaders serve as consultants for curriculum, programming, assessment design and evaluation
   e) there are designated offices for community involvement and learning and/or faculty and staff who have dedicated responsibilities for community-based learning

9. Evaluation and Assessment**
   a) focus on key learning outcomes to be assessed
   b) development of plans of study for all students
   c) provision of diagnostic, milestone, and culminating assessments of key learning outcomes
   d) assessment of student achievement in context of academic and citizen work
   e) publicizing learning outcomes and expectations and how they can be achieved

10. Reward Systems
    a) clarity of expectations for rewards across campus units
    b) reward systems consistent and clear across campus units and campus populations
    c) equity within the system
    d) systems of consistent feedback and opportunity for improvement
    e) recognition of individual differences and contributions to the larger community

Overall, the campus climate is assessed in two ways:
   a) by each dimension and the consistency with which the dimension is addressed in multiple aspects of the campus; and
   b) by a sense of how well the campus is doing in addressing all five dimensions of personal and social responsibility and how clearly the dimensions are a part of the comprehensive educational mission of the institution.


** Taken from Our Students’ Best Work: A Framework for Accountability Worthy of Our Mission (AAC&U 2005), with outcomes intended to span all five dimensions of personal and social responsibility.

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CORE COMMITMENTS:
Educating Students for Personal and Social Responsibility

Personal and Social Responsibility Institutional Matrix

Overview
This Institutional Matrix is designed to help you map your institution's overall commitment to education for personal and social responsibility (PSR).

Matrix Elements
The Matrix (pp. 2-8) consists of one chart for each of the five dimensions of personal and social responsibility that are central to the initiative, a summary sheet, and an asset-gap analysis sheet. It is comprised of three elements:

Horizontal Axis: The Five Dimensions of PSR
See Appendix 1 (pp. 9-14) for a list of the five dimensions and a description of traits associated with each. As you fill out your matrix, we invite you to expand upon and refine the traits as they are described here.

Vertical Axis: Domains of Campus Culture
See Appendix 2 (p. 15) for a list of five domains of campus culture. As with the list of traits, we invite you to refine and expand on this list so it is appropriate for your particular institution. Mapping education for PSR across these domains should help you determine where your institution has assets and gaps.

Rating Box: The Degree of Pervasiveness of Campus Efforts
See Appendix 3 (p. 16) for more information on determining the degree of pervasiveness of campus efforts. The matrix asks you to consider two mutually reinforcing aspects of institutionalization—breadth and depth. Significant breadth and depth would be demonstrated by effective, sustainable, and comprehensive institutionalization of programs, policies, and procedures that support education for PSR.

Completing the Matrix
Preferably with colleagues, map your institution's commitment to education for personal and social responsibility using this matrix. Use the space in the boxes provided to catalogue the programs, policies, and initiatives that fall into specific domains of campus culture (vertical) and dimensions of personal and social responsibility (horizontal) (e.g., an annual diversity fair would be listed under the domain of campus life and under Dimension 4: Taking Seriously the Perspectives of Others).

Use sources of knowledge readily available to you: information in catalogues and on your institution's web site, the experience of your colleagues, etc. As you work together to fill in the matrix, think of yourselves as your institution's cartographers, mapping how your institution visibly reveals its core values related to education for PSR.

The rating boxes on the charts allow you to indicate the degree of pervasiveness for each dimension, across each domain. Use the following scale to fill in these boxes: Low (L) = no breadth and no depth (i.e., isolated and superficial attempts at educating students for PSR); Medium (M) = some breadth and/or some depth; and High (H) = strong breadth and strong depth (i.e., integrated and embedded PSR education).

Summary and Asset-Gap Analysis
When your matrix is completed, fill in the summary sheet located on page 7. Then examine both the assets (patterns of clearly established programs and policies) and the gaps (areas where education for PSR is missing). As a group, ask yourselves what made your assets possible? What caused gaps to occur? From there, fill in the asset-gap analysis sheet located on page 8.

Core Commitments is supported by a generous grant from the John Templeton Foundation.
# Personal and Social Responsibility Institutional Matrix – Summary Sheet

Summarize the scope of your institution's efforts to educate for personal and social responsibility

<table>
<thead>
<tr>
<th>Dimension 1</th>
<th>Dimension 2</th>
<th>Dimension 3</th>
<th>Dimension 4</th>
<th>Dimension 5</th>
<th>Degree of Pervasiveness (L, M, or H)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Striving for excellence</td>
<td>Cultivating personal and academic integrity</td>
<td>Contributing to a larger community</td>
<td>Taking seriously the perspectives of others</td>
<td>Developing competence in ethical and moral reasoning</td>
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</tbody>
</table>

**For this column, put the score (L, M, H) that you feel most accurately reflects the state of education for PSR in this particular domain of campus culture.
<table>
<thead>
<tr>
<th>Personal and Social Responsibility Institutional Matrix – Assets and Gaps Analysis Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Please describe your institutional assets – areas where institutional commitment to education for PSR are visible and well-connected.</td>
</tr>
<tr>
<td>2. Please describe your institutional gaps – areas where efforts at educating for PSR are not pervasive across your institution.</td>
</tr>
<tr>
<td>3. Please list any pressing questions that may have emerged for you during the matrix process.</td>
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</tbody>
</table>
The Equity Scorecard™ Tool

The Equity Scorecard™ is a data tool, or summary report card, which captures the results from an evidence team’s inquiry activities and the actions a college will take to meet its graduation goals. These include improvement and equity objectives that can be monitored yearly, as well as over a longer period of time. The completion of the Equity Scorecard™ is the culminating event of the five-phase process.

More importantly, the Equity Scorecard™ documents the institution’s efforts to address inequity. This is a critical difference between the Scorecard and other assessment measures, which tend to focus only on student efforts. By reframing assessment methodology to look at institutional responsibility, the Equity Scorecard™ shifts attention to what is going on in the classroom and in student support services. This enables practitioners to examine more than their students’ grades; it will help them reflect on their course syllabi, materials and instructional strategies. Administrators will also be able to evaluate their staff and faculty professional development efforts so that they can be more effective in meeting their students’ academic needs.

Take a Closer Look at the Equity Scorecard™
As shown in the graphic, the Scorecard provides baseline data on key indicators like access, retention, excellence and completion, and campus effort for student groups broken down by race and ethnicity. The college then determines what its annual and longer-term equity goals will be for specific measures of those indicators.

With this “report card,” a college can track how well it is doing in meeting its goals and share the results with its key constituencies. It also provides the institution with criteria to evaluate its progress in closing the equity gaps and improving college completion rates for all students.

With this “report card,” a college can track how well it is doing in meeting its goals and share the results with its key constituencies.

It provides an institution with criteria to evaluate its progress in closing the equity gaps and improving college completion rates for all students.

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Facilitating Interdisciplinary Learning: Lessons from Project Kaleidoscope

by Adrianna Kezar and Susan Elrod

Many major funding organizations, policymakers, government agencies, and other higher education stakeholders want higher education to encourage interdisciplinary learning so that students graduate with the requisite skills to take on complex jobs in science, policy, business, and industry. Calls for this kind of change have been most urgent within the science, technology, engineering, and mathematics (STEM) fields; they are key to America’s capacity to maintain its global economic position, yet their enrollments have been shrinking in recent years. Studies have demonstrated that students with exposure to interdisciplinary learning experiences tend to be retained as majors, as well as gaining preparation for successful careers and life in the 21st century.

Moreover, two reports from the National Academies of Science (Facilitating Interdisciplinary Research, 2004 and New Biology for the 21st Century, 2009) note that research in many scientific disciplines is becoming more interdisciplinary, requiring graduates who are capable of working across boundaries.

The National Academies' Facilitating Interdisciplinary Research (2005) was produced to help institutions understand how to systematically encourage interdisciplinary research by changing academic organization and culture. The report examined various institutional structures and practices that hamper interdisciplinary work, such as reward systems, funding protocols, and competition among departments. It also identified the necessary conditions of progress, such as a vision for interdisciplinary work, startup resources, cross-campus dialogues, collaborative research facilities, and incentives. The report casts the lack of progress in doing interdisciplinary research and learning as an institutional challenge, not as the issue of individual competency or motivation it is sometimes thought to be.

Project Kaleidoscope (PKAL) too has been looking at systemic ways to create interdisciplinary teaching and learning environments. Like the National Academies report, PKAL thinks that campuses across the country have not created environments hospitable to interdisciplinarity. In this article, we highlight research conducted on one of the major projects facilitated by PKAL: Facilitating Interdisciplinary Learning (FIDL), funded by the W.M. Keck foundation (at http://www.aacu.org/pkal/interdisciplinarylearning/index.cfm). The central premise of the project’s leaders was that higher education institutions will not create the innovative and complex thinkers of the future unless campuses reshape their processes and policies.

For three years (2007–2010) the FIDL initiative brought together teams from 28 institutions of diverse types in order to foster more intentional interdisciplinary learning; connect various interdisciplinary initiatives; and learn about successful strategies for planning, evaluating, and institutionalizing interdisciplinary programs. Two hundred and fifty faculty and campus leaders participated in four national meetings, including two roundtables focused on assessment and leadership.

The campuses concentrated on the creation of integrative learners, faculty and students with the skills and confidence to work at the interfaces between disciplines to address both research questions and complex societal problems. One-third
of campus teams worked on programs in the sciences and mathematics disciplines; two-thirds created programs that incorporated a broader range of disciplines.

This project was unique in that it focused on what campuses can do to support interdisciplinary learning (rather than simply research) and provided five practical strategies (see box below) for launching such efforts in ways that lead to broader campus support and longevity.

**Five Strategies from the PKAL Facilitating Interdisciplinary Learning (FIDL) Initiative**

- Start by articulating a common understanding of interdisciplinary learning goals that will drive the cycle of curricular innovation, development, assessment, and improvement.

- Use assessment to connect those goals with program structure, content, and pedagogy, paying attention to students as individual learners who come with diverse backgrounds, experiences, expectations, career aspirations, and goals.

- From within and with new hires, build a critical of mass of faculty and staff who assume leadership responsibility in the iterative process of shaping interdisciplinary curricular and co-curricular approaches and in assessing the impact of those approaches on undergraduate learners.

- Incorporate interdisciplinary program needs into the processes of campus governance and the distribution of resources: money, personnel, equipment, and spaces.

- Align interdisciplinary learning with the institutional vision, mission, and identity, and include it in strategic planning at all levels.

This project is among the largest to examine the facilitation of interdisciplinary learning. The project researcher (Adrianna Kezar) and the project leaders (Jeanne Narum, then the director of Project Kaleidoscope; Michael Kerchner, associate professor at Washington College; and Susan Elrod) surveyed the teams at the beginning and end of the project, received annual reports from the campuses, and conducted interviews after the projects were completed. We also had documentation along the way from meetings, roundtables, workshops, and conference calls. (For additional details on the project, see the summary report—Project Kaleidoscope, 2011—in Resources).

**Participating FIDL Campuses**

Agnes Scott College

Beloit College

Bradley University

Canisius College

College of St. Benedict and St. John's University

Davidson College
In this article, we report on the lessons learned from this initiative in how to bring interdisciplinary learning to scale. But first, we briefly review the institutionalization theory that we used to frame our findings.

**Institutionalization Theory**

Kezar and Lester's (2009) research on facilitating collaboration in higher education informed both the project administration and the research we conducted on the 28 campuses. Their work identified institutionalization as crucial in institutions' capacity to create and sustain a campus culture that supports interdisciplinarity.
A three-stage model of institutionalization emerged from the literature and from Kezar and Lester’s study: mobilization—“the system is prepared for change”; implementation—“the change is introduced”; and institutionalization—“the system is stabilized in its changed state.” In the \textit{mobilization} stage, the organization begins to prepare for change. This preparation ranges from developing an awareness of the need for change, creating vision, galvanizing support through intensive and extensive discussion, and mobilizing leadership and collective action. At this stage, change agents begin to challenge the status quo (i.e., practices and policies that characterize the current institutional culture).

\textit{Implementation}, the second stage, focuses on creating infrastructure and support for the reform, which may take the form of revised rewards and incentives, new facilities, additional resources, altered teaching loads, and the like. During this stage, initiatives begin to materialize, and support for the innovation is developed to maintain momentum.

\textit{Institutionalization} is the final stage of the process, in which the innovations are incorporated into the value systems, culture, and day-to-day norms of the institution. Members come to a new consensus, accept the value of the innovation, and see it as normative for the institution. Core understandings are altered. Also, people are held accountable for enacting the new norms in the institution’s evaluation systems. Thus, discussion about interdisciplinarity is no longer necessary; people automatically create supportive structures for it, since it is now everyday practice.

Few campuses have institutionalized interdisciplinary learning.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{PROJECT KALEIDOSCOPE THREE-STAGE MODEL FOR CHANGE}
\end{figure}

\textbf{MOBILIZATION}

\textbf{Understanding}

Risk aversion was a real barrier to reform on the PKAL campuses, according to three-quarters of the participants at both the beginning and end of the project. [Editor's note: See the John Tagg article in this issue for a discussion of faculty resistance to change.] But mobilizing faculty for any type of curricular reform is virtually impossible if there is no understanding of it. \textit{Interdisciplinarity} is a much-used, yet mostly misunderstood concept. Even on campuses that have a history of doing interdisciplinary work, there is generally little shared understanding of the term.

Many faculty see interdisciplinarity as a threat to disciplinary work. Campuses need to address this threat by differentiating among the terms \textit{interdisciplinary, multidisciplinary} and \textit{transdisciplinary} and examining how these concepts complement—and can support rather than replace—disciplinary work.

Faculty are unlikely to create coherent interdisciplinary learning goals or environments unless they have in-depth discussions with colleagues from different fields about what interdisciplinary teaching, learning, and scholarship mean.
to them as individuals, departments, and schools and how interdisciplinary learning outcomes differ from disciplinary ones. As a member of one of the project teams said about the importance of these dialogues, “I cannot imagine how we would have made progress without coming to a common understanding about what interdisciplinary work is and what type of learning environments we were trying to create.”

Teams found that by participating in the FIDL project, they learned the language of interdisciplinary work and ways to frame productive discussions on campus: “The framing and language provided by PKAL was essential for advancing our interdisciplinary work and helping us communicate with other colleagues on campus. We had failed in earlier attempts to get more broad buy-in,” said one participant.

One aspect of framing is to make clear that people on campus are already doing interdisciplinary work. It is easier to get cooperation if you are not asking everyone to do something new. A faculty member at one college put it this way: “One of the key lessons that came out of some of the project roundtables and meetings was that people realize they need to amplify and focus on existing interdisciplinary work rather than frame it as being new.”

**Concretization**

If faculty do not advance to concrete discussions of the curriculum and their day-to-day pedagogical practices, the effort is likely to get caught up in more abstract discussions and falter. Furthermore, it is important that faculty leaders make the case for interdisciplinary learning in the context of the way scientific research is actually done in the 21st century: It is more interdisciplinary and focused on real-world problems, as well as workforce-development needs, than prior work.

Then discussions can move to what students should know and be able to do as a result of their interdisciplinary learning experiences. These conversations can take time, since members need to navigate different disciplinary perspectives and cultures, but those teams that had had these discussions moved forward faster and experienced fewer barriers than ones that had not.

At one of the project meetings, campus leaders came up with a list of overarching interdisciplinary learning goals (see the box below).

**PKAL Undergraduate Learning Goals**

As a result of intentional interdisciplinary learning experiences, students will be able to:

- Recognize disciplinary strengths, processes, limitations, and perspectives.
- Purposefully connect and integrate knowledge and skills from across disciplines to solve problems.
- Synthesize and transfer knowledge across disciplinary boundaries in the context of novel situations.
- Be agile, flexible, reflective thinkers who are comfortable with complexity and uncertainty and can apply their knowledge to respond appropriately and positively.
- Understand that a host of factors—cultural, political, ethical, historical, and economic—must be considered when addressing the complex problems of this century.
• Understand the universal nature and deep structure of science, as well as the relationship of the disciplines to each other.

• Be prepared for future learning as lifelong learners in their careers and as citizens.

• Apply their capacity as integrative thinkers to solve problems in ethically and socially responsible ways.

• Think critically, communicate effectively, and work collaboratively within diverse cultures and communities.

Campuses undertaking this process can use the list as a starting point. Once they develop interdisciplinary learning goals particular to their campus and that they can own, faculty should distribute them widely to different stakeholders, both within and outside of the institution (e.g., alumni and employers). The broader the support for the goals, the more likely it is that there will be backing for the programs and curricula designed to produce interdisciplinary learning. As one team leader commented,

*Interdisciplinary learning, because it is new, needs a broad-based buy-in just in case a set of individuals starts to question our learning goals. When a set of faculty start questioning, it is a lot harder for them to challenge our goals if there is broad buy-in by students, alumni, and other campus colleagues.*

It also helps if faculty change agents connect the goals to the institutional vision, mission, and strategic plan. For example, faculty at one institution knew that its strategic plan focused on connecting more to the local and regional area. Thus they emphasized how interdisciplinary learning could support community engagement through efforts to clean up the environment, understand and address poverty, encourage organic farming, forge better human services, enable economic development, and protect endangered animals.

Faculty leaders also need to mobilize people around the concrete changes that are needed in order to facilitate interdisciplinary learning. Most important, they should examine current curricula and pedagogical approaches to assess their capacity to do so, then explore what might replace the less successful ones. For example, co-teaching might be encouraged or faculty development programs initiated to help faculty engage students in problem-based learning. In that process, learning goals should be linked to assessment measures to ensure that the new teaching and learning strategies are effective.

**Recruitment**

A final step in mobilizing faculty and staff to create interdisciplinary learning experiences for students is to develop a critical mass of faculty who support the change. Many early interdisciplinary learning initiatives were built on the interest of a few faculty members who created an environmental studies program or a minor in poverty studies. While these efforts led some faculty to teach in new ways, they did not engage the large numbers necessary to reach many students with interdisciplinary learning experiences.

While not all faculty need to participate, having a critical mass of individuals across multiple departments who are supportive of interdisciplinary learning makes it easier to get curricular changes through curriculum committees, gain support for hiring interdisciplinary faculty, and obtain funding to support pilot initiatives. Having faculty who understand and are willing to support such initiatives is necessary groundwork for the implementation phase.
PKAL was able to foster the development of that critical mass of faculty by suggesting that campuses inventory existing interdisciplinary efforts, create an informal network of the faculty involved, and provide them with mentoring and development opportunities. A faculty member at one participating university described the importance of networks:

\begin{quote}
In the past, isolated interdisciplinary efforts had some success; some are even still on campus, but others waned over time. As we talked about bringing interdisciplinary work to a broader scale, we recognized that it was important to connect different faculty across campus that were doing interdisciplinary work, and this would begin to create a critical mass. Next we used dialogue to bring in other people.
\end{quote}

Our survey of campuses found that a strong campus team was the number-one strategy for moving forward. One leader described how they built such a team: “Part of it is that we strategically choose people from different areas and with different expertise and background. But the leadership development and support from PKAL was instrumental helping these members to understand vision development, team building, and leadership and change strategies.”

High-functioning teams had similar characteristics: They had regular interactions, documented their progress, created an open and experimental mindset that fostered innovation, and had a fluid and interdisciplinary membership. In several cases, campus teams added members after the learning goals of the program were established because they realized they needed additional disciplinary expertise.

\section*{IMPLEMENTATION}

Once faculty have been mobilized through cross-campus dialogues regarding interdisciplinary learning goals, curricula, pedagogy, and assessment; a strong campus team is in place to drive the initiative; and a critical mass of faculty support interdisciplinary learning, then faculty can move to implementation by obtaining resources, adjusting campus processes and policies, developing incentives, creating pilot courses and programs, and assessing student learning.

\section*{Resources}

The PKAL participants recognized that departments could feel threatened by interdisciplinarity: “In these lean times, there is competition for funding, and any initiative that threatens to take resources is a threat to the mainstream curriculum and is typically viewed with suspicion. This is one challenge we knew we would face,” said one. Departments vie among themselves for resources (money, faculty time, facilities, etc.), and they may see interdisciplinary programs as just another competitor.

And indeed, in the post-project survey, “competition with department interests/needs – disciplinary turf” was still seen as a significant barrier to interdisciplinary work, albeit a less significant one than originally anticipated (81.3 of participants agreed with the statement at the beginning of the project; 62.5 percent did so at the end). Departmental teaching obligations were a major impediment to freeing up the time for interdisciplinary teaching (84 percent of participants thought that release from those obligations was “difficult” or “very difficult” to negotiate, both at the beginning and the end of the project).

But campus leaders recognized that there were ways to address this issue. In order to reduce the expense and amount of faculty time devoted to team teaching, for instance, some campuses created policies that within three years one faculty member should have developed the expertise to teach the course. Another approach was hiring faculty with interdisciplinary backgrounds who could do that from the beginning.

But there is no doubt that a lack of resources can constrain new initiatives: Three-quarters of the participants identified that lack as a major barrier both at the beginning and end of the project (although, interestingly, the 56.2 percent of faculty who, at the beginning of the project, thought that “inadequate facilities” would hamper their efforts had dropped
Interdisciplinary efforts may have to create at least some resource-neutral approaches in order not to jeopardize their chances of moving forward in these resource-constrained times.

However, the survey data and interviews also confirmed that departmental competition can be addressed, both by aligning interdisciplinary learning with institutional goals and through campus dialogue. One team member said, “While competition between departments is a significant issue in bringing interdisciplinary efforts to scale, the work we did with campus dialogues really helped diffuse the departmental resistance we felt in the past.” When they entered the project, three-quarters of the participants did not feel sanguine about such campus-wide discussions occurring; that percentage had dropped to 31.3 by the end.

And there was some external funding available to support pilot programs and courses or for research to analyze learning outcomes. A member of one university team discussed this issue: “We knew that if we wanted to get this project off the ground that leveraging some outside funding would be extremely helpful. Funding isn’t as important at all campuses, but at a large research university we found it was critical to implement our initiative.” External funding not only enables the work—it also sends signals about its importance in the larger higher education universe.

**Policies and Processes**

Implementation of interdisciplinary programs requires an amount and kind of attention to campus policy and infrastructure issues that most project teams did not anticipate. For instance, some participants talked about their initiatives stalling within curriculum committees:

> We submitted our new ID learning courses to the campuswide committee. We didn’t hear anything for a year, and when we inquired we were told that they didn’t have any templates or tools to evaluate our courses as submitted. They said they been working to create different guidelines and just hadn’t been able to get support from anyone. We should have anticipated that this could be a dilemma and we could have developed guidelines. Our task force got extremely frustrated and after year and a half of sitting around waiting for a response, people dropped out of the group. We were worried we might not move anything forward.

One group of faculty described the difficulty in hiring some interdisciplinary colleagues because the search committees did not know how to evaluate their credentials. The next year they developed a set of guidelines for interdisciplinary hires, and the process went more smoothly.

**Incentives**

At both the beginning and the end of the project, two-thirds of the participants considered an absence of incentives and rewards to be a significant impediment to change. Most campuses focused especially on the need to revise their guidelines for tenure and promotion in order to make lasting progress; many used the recommendations of the Council for Environmental Deans and Directors as a starting point ([http://ncseonline.org/CEDD/cms.cfm?id=2042](http://ncseonline.org/CEDD/cms.cfm?id=2042); Also, see Pfirman, Collins, Lowes and Michaels [2005]).

Incentives for continued involvement in interdisciplinary initiatives were key to the success of those initiatives. A faculty member at one university talked about this issue on her campus:
While you can get an interdisciplinary initiative off the ground with the passion and inspiration of a set of faculty, you can’t sustain it on their passion. Lots of the senior faculty talk about interdisciplinary initiatives that have come and gone, and many do not recognize that a lack of incentives is part of the issue. Over time, people burn out if there is no support for the work. So we’re really grappling with how to make this much broader interdisciplinary initiative have the type of incentives behind it that will maintain people over the long run. This is even more important for junior faculty members who are still going through the process of tenure and promotion.

Beyond acknowledgment in annual reviews or promotion and tenure decisions, project participants named as important incentives course release, additional money for course creation, full credit for team teaching, and recognition at annual events and in campus publicity. Since monetary incentives can be challenging to come by in these tight budget times, others mentioned non-cost strategies. In order to relieve any one person of too much work, on one campus they came up with another solution: to “involve people through short-term task forces where they feel their time is being well spent.”

**Assessment**

A critical implementation step on many campuses was the creation and study of an experimental course to fine-tune practices. Such a course creates the opportunity to demonstrate what interdisciplinary learning looks like from week to week and throughout the semester, demonstrate new types of assignments, allow faculty to observe different pedagogical styles, and assess (for purposes of comparison) learning outcomes in both interdisciplinary and traditional courses.

Several faculty were able to demonstrate that students learned more on a variety of measures in their interdisciplinary courses, which legitimated them. Ongoing assessment can provide data that demonstrates how interdisciplinary courses can foster the kinds of learning that complement disciplinary objectives.

But assessment is a major challenge in the implementation process, since it does not come easily to many faculty members. One participant described the problem and how the faculty network helped solve it:

> As higher education faculty we’re not good about measuring student outcomes in general, and measuring interdisciplinary learning objectives becomes even more complex. It really helped to be part of this network so that we could exchange ideas about how to measure interdisciplinary learning goals, as well as familiarize ourselves with existing instruments that might be used.

Other outcomes may also come out of the pilot course. One faculty member spoke about the value of creating pilot courses in terms of recruitment into the major:

> I think one of the best strategies we used was the creation of a course that was a laboratory for us to try out the ideas that came up our campus team. Also, several students in our course were non-science majors but changed to be science majors after our interdisciplinary course. When we compare this to the other courses, they were not having the same effect of getting students to change their majors to science. We disseminated those results widely, and this data has been one of the best supporters for implementing interdisciplinary work. We are really actively trying to get more students into STEM majors, and this seems to be one way to do it.
Assessment Instruments

- National Survey of Student Engagement (NSSE)
- Faculty Survey of Student Engagement (FSSE)
- Collegiate Learning Assessment (CLA)
- Biology Self-Efficacy Scale
- Science Literacy Scale
- Self-Determination Scale
- Views about Science Survey (VASS)
- Summer Undergraduate Research Experiences (SURE)
- Classroom Undergraduate Research Experiences (CURE)
- Research on an Integrated Science Curriculum (RISC)
- Student Assessment of Learning Gains (SALG)
- Field-Tested Assessment Guide (FLAG)
- Course evaluations/student evaluations of faculty
- Embedded exam questions
- Higher Education Data Sharing (HEDS) and other institutional data (e.g., course/program retention)
- Association of American Colleges & Universities (AAC&U) VALUE rubrics

INSTITUTIONALIZATION

As of this writing, most of the project teams are implementing their interdisciplinary learning initiatives; few have reached the phase of institutionalization. That process takes five to ten years, and most projects have only been going for three. Yet some of the campuses have made strides towards institutionalization, and the lessons they have learned may be helpful to other institutions.

Integration

If interdisciplinary work is to become part of the regular work of campuses, then it needs to be integrated into day-to-day processes besides promotion and tenure review, mentoring, faculty development, and the like. Fundraising, facilities planning, budgeting, program review, strategic planning, and accreditation are all areas in which the PKAL campuses encountered barriers that stalled their efforts.
Campus teams in the post-program survey cited a lack of appropriate administrative processes as one of the most important barriers. Some used strategic planning or accreditation as opportunities to bring up problems that they were encountering in realizing the promise of interdisciplinary learning. As one faculty member said,

_The self study process allows us the opportunity to more fundamentally rethink our functioning, and that is a very hard awareness to penetrate. You have to capitalize on these few opportunities where the institution is consciously thinking about its functioning._

As alluded to in the implementation section, campuses that made the most progress had evaluated various departmental and institutional policies and noted where they were unsupportive of interdisciplinary work so they could be modified to facilitate it. Changing campus processes is one of the most difficult aspects of interdisciplinary work, and many campuses are still in the process of making those changes.

**Legitimization**

Another critical step towards institutionalization is transforming departmental cultures so that they value interdisciplinarity and do not see it as a threat to disciplinary learning. The early conversations about interdisciplinarity begin to foster respect for the work, yet much more is needed to demonstrate its legitimacy.

One strategy is to bring in high-prestige outside speakers. As one PKAL participant commented, “We had a series of outside speakers come to our campus and that made all the difference; suddenly we (the interdisciplinary initiative) were more legitimate. They were also very inspirational to people in a way, we (on campus) were not able to be.” Some guest speakers that PKAL brought in to reshape campus attitudes were James Collins (Arizona State University), Jay Labov (the National Academy of Sciences), Wanda Ward (the National Science Foundation), Stephanie Pfirman (Barnard College), Jose Mestre (University of Illinois, Urbana Champaign), and Karen Kashmanian Oates (Worcester Polytechnic Institute). (See the PKAL project website at [http://www.aacu.org/pkal/interdisciplinarylearning/index.cfm](http://www.aacu.org/pkal/interdisciplinarylearning/index.cfm) for other suggestions.)

The experimental courses and learning outcomes assessment created further evidence about the value of interdisciplinary work, especially when linked to institutional goals. Thus, all the earlier strategies culminate to create institutionalization over time.

**KEY LESSONS**

**Leadership**

Recently, *interdisciplinary* has become a term that can be seen in the strategic plans of a host of campuses, so campus leaders are increasingly acknowledging its importance, at least in theory. But most interdisciplinary efforts originate when a few faculty members coalesce to create a course, minor, or program of study. Many project teams bemoaned the lack of support from their campus administrations as they tried to initiate interdisciplinary work.

Few colleges have worked from both the bottom up (capitalizing on faculty interests) and the top down (providing support from the administration) in promoting such efforts. For interdisciplinary work to come to scale, we need both kinds of leadership. While top-down support can make interdisciplinary work happen more quickly, teams cautioned that unless there is buy-in from the faculty, interdisciplinary work is not likely to be sustained.

Many PKAL teams described the importance of allowing faculty to initiate conversations and experimental courses so that interdisciplinary work does not seem imposed. One campus team credited its success to an initial buy-in from faculty that was followed by support from the administration.
It is significant that half of project participants anticipated that a “lack of coherent leadership vision” would impede their progress, whereas by the end of the project, none said that it had. Nevertheless, senior administrative turnover became a problem on campuses that experienced a shift in deans, provosts, and presidents. However, sharing leadership widely was a way to ensure that there were enough players to continue the effort. One participant commented on the importance of this leadership model and how to create it:

Distributed leadership really accounts for how we successfully created change. All units involved in the interdisciplinary general education project are part of a network of individuals working to transform the curriculum. The reason it helps so much is that the distributed leadership spreads out the workload of such a massive project and creates a representative group of people that can ensure that the various cultures and language of different disciplines are respected in the change process. We built the network over time because we had worked on many earlier interdisciplinary initiatives and so there was an existing group of natural champions and leaders for interdisciplinary work. While we had that network, it can also be built on campuses that do not have it.

**Barriers**

An important lesson from this project is that institutions tend to overestimate barriers and that this overestimation can be a deterrent to action. When we interviewed campus teams at the end of the project, they noted that they had become better judges of the real barriers (perhaps as a result of the discussions within PKAL-sponsored meetings) and less anxious about ones that did not exist or were not as high as expected. A faculty member commented on this issue:

There is a propensity to think that the resistance will be stronger, but really people are so busy in many different directions that it is less than expected. Each campus in the project also got better at recognizing and anticipating what the barriers would be for their campus. I guess the lesson is to not firmly believe you know what the barriers or resistance might be; the administration might make it a priority even if you think they will not. You do need to manage challenges, but you have to realize you may not know exactly what they are at the outset.

We have mentioned the most significant barriers in the course of this article: departmental resistance and competition, a risk-averse culture, a lack of resources, and an absence of incentives. But with deliberate attention and persistence, most campuses found ways to overcome them.

**Surmounting Barriers**

- Ensure that interdisciplinary programs have the same rights and responsibilities as disciplinary programs, from program approval to program review.
- Ensure that interdisciplinary faculty and/or program directors are present at budget and other institutional planning and governance meetings.
- Create transparent financial policies, including criteria for how budgets are established and reviewed; align program aims with needed resources.
- Create governance documents or memoranda of understanding to make explicit the structural support and resources that interdisciplinary programs have.
• Visibly support interdisciplinary projects with travel funds, meeting space, and course release/reassignment; ensure that administrative leaders attend interdisciplinary project planning meetings.

• Funnel indirect costs recoveries from interdisciplinary grants to interdisciplinary faculty development or interdisciplinary team teaching.

**Networks**

Campuses capitalized on both on and off-campus networks to create support for interdisciplinarity. Earlier we noted that successful change agents map other interdisciplinary efforts and connect to related work. Beyond the ones on campus, national networks can inspire and inform change. Through participation in the PKAL network, the project campuses learned about change strategies, leadership approaches, and barriers to avoid or surmount. While the formal project has come to a close, the PKAL network is still here to support these campuses and others developing interdisciplinary programs, as well as programs that significantly improve the learning and achievement in undergraduate STEM fields.

In the words of one faculty member, “The network kept us focused on key strategies, made us attuned to ways to overcome barriers and not to get overwhelmed. Hearing other people were able to do it, made you believe you could as well.” We invite you to visit the PKAL website for additional details on this project, including a summary report of key strategies and campus case studies, and to take advantage of its on-going events and resources.

**RESOURCES**


In Liberal Education and other important higher education publications, we routinely read about effective innovations that are known to promote student success: assessment; engaged, integrative, and interdisciplinary learning; collaboration and partnerships; global perspective taking; among a host of others. The fact is, however, that such innovations often remain just that—innovations, rather than common practices. We certainly do not lack ideas for improving instruction in ways that help students learn more effectively, but we do lack ideas for spreading pedagogical innovations and broadening “ownership” of them on campus. One of the dilemmas that policy makers, campus leaders, and individual faculty members often describe with chagrin is the difficulty of scaling up successful innovations. Officials at the National Science Foundation (NSF), for example, admit they are discouraged because the results of most NSF-funded projects are not disseminated beyond the target faculty or institution. The NSF has relied largely on a research and development model of innovation diffusion: a key innovation is created and tested, and then the evidence of its efficacy is distributed; ideally, others will adopt the innovation based on the information about its value (Rogers 1995). But this model has proved wanting; faculty are not adopting the effective innovations.

In higher education, we tend to think more about the content of the innovation and less (if at all) about its implementation or dissemination. In this article, I describe two fundamental problems related to this dilemma: (1) we largely ignore models about how to scale up change and, therefore, tend to rely on isolated practices that are unlikely to lead to broader dissemination; (2) those who do adopt models of scale-up often look to policy literature for guidance and, as a result, advance dated approaches that are not well aligned with the higher education system. Next, I argue that two particular models—mutual adaptation and social movement—are much more likely to lead to widespread and lasting change in higher education, and I describe the key mechanisms that help facilitate these promising approaches to scale-up.

The need for greater intentionality and thoughtfulness

The first point, about a lack of thoughtful dissemination, I will address only briefly. Campuses have adopted a handful of strategies intended to encourage the wider dissemination of successful innovations, such as offering professional development workshops or providing seed funding. These dissemination strategies can also be found in proposals to the NSF and the Fund for the Improvement of Postsecondary Education (FIPSE) for the funding of projects that are intended to achieve broader scale. While professional development and seed money can be helpful in themselves, they are not being utilized in ways that attend to the entire change process. Professional development may help a faculty member better understand the change, but it does not provide either incentive to change or ongoing support for change. Seed money may provide incentive, but faculty members may still face departmental barriers...
that the funding does not help them overcome. One-off solutions to dissemination and support
do not help achieve systemic change and scale-up.

Second, much of the available information about scaling up innovations comes from policy
research and applied subfields like international or community development (Dede 2006). If
educators do adopt a change model, it may not be one with proven success in education.
Within policy circles, scale-up is typically understood to involve the application of an
innovation that has been proven successful in one setting to a wide range of other settings
(Healy and DeStefano 1997). It is assumed that success is independent of the implementation
setting, or that successful innovations can be readily applied to other contexts without
modification or alteration. It is also assumed that reform begins with small pilots, which are
tested and then distributed without consideration of the actors or contexts of subsequent
settings. According to these traditional models of scale-up, innovation is imposed externally
and represents outside influence. Through funded projects, for example, innovations can be
created and tested by faculty and then distributed to various sites—with little or no investment
provided for implementation at the new sites.

There are several problems with these traditional models of scale-up. Cumulative evidence
has shown that they are not effective in many situations, and that they are wholly ineffective in
education—particularly in the K–12 context, where many such models have been applied.
Without modification or adaptation, innovations are not easily transferred to other settings.
School reform efforts, for example, are much more successful when they are modified to fit the
particular school setting (Datnow et al. 1998).

Moreover, researchers now recognize that scale-up is more likely to succeed if the innovation
was developed organically within a school or setting, rather than created at a lab or off-site
location and imposed externally. For example, Healey and Destafano (1997) have noted that
teachers, parents, and students should be involved in the design, development, and
implementation of innovations intended to solve problems related to their own situations. Also,
traditional models of scale-up are often rooted in an understanding of innovation as static and,
therefore, readily applicable to different contexts, even as circumstances change over time.
Yet, scholars in the development field have come to realize that communities are dynamic, and
that the beneficial changes they bring to scale need to be organic and to change with
circumstances (Samoff, Sebante, and Dembele 2003).

Another problem with traditional scale-up models concerns incentive or motivation. Many
efforts at educational reform ignore whether or not there is interest within the community.
Generic definitions of scale do not examine motivation or the interests of particular actors, and,
as Elmore (1996) has noted, efforts rooted in such definitions are unlikely to be successful.
Also, scale-up works better when individuals or groups working in local settings are connected
to a network of others who are also involved in similar efforts. Through such networks,
innovators can support one another and help resolve issues of implementation, motivation,
and ownership. Networks can also provide the leadership needed to create and sustain
change in particular settings.

These problems with traditional models of scale-up are powerfully demonstrated in Elmore’s
(1996) evaluation of NSF school reform and scale-up efforts over twenty years. Elmore
concluded that the incentive structure in schools works against any attempt to change core
activities, and that reform efforts will never reach scale so long as the model of scale
continues to ignore the need to alter basic organizational structures—i.e., the implementation
context. He also concluded that the problem of scale will not be solved so long as incentives
remain limited and innovation is viewed as an individual trait of charismatic innovators, rather
than as a normative requirement of good teaching. Good practices should be openly and
publicly debated on a regular basis, and educational institutions need to build structures that
promote ongoing learning. In the end, Elmore noted, we need to recognize that the issue of
scale is an issue of cultural norms and incentives that cannot be fixed with simple policy shifts,
grant money, or pilot-tested innovations imposed through traditional scale-up models.

In a similar critique, Coburn (2003) demonstrated that innovations in schools usually falter
because they do not achieve depth or alter the norms of teachers. Even schools that
successfully implement reforms have difficulty sustaining them in the face of competing
priorities, changing demands, and teacher and administrative turnover. Too often, practices
change, but underlying beliefs do not. Hence, once pressures to use the new practices have
lessened or disappeared, people tend to return to old habits. Bringing deep, systemic changes
to scale requires a thoughtful and systemic approach—and one that addresses the critiques of
traditional scale-up models.
Models for scaling up change in higher education

Both mutual adaptation and social movement models address all the critiques of traditional scale-up models, and they have the potential to bring marginal pedagogical innovations to scale in higher education. Mutual adaptation involves a flexible process that is negotiated between developers and educators, and its design reflects local needs while still holding true to the original nature of the innovation (Datnow et. al. 1998). Because external groups are in place to provide the infrastructure, the mutual adaptation model can make available incentives and structures to support the improved practice at a relatively early stage. One way to achieve mutual adaptation is by creating learning communities through which educators deliberate on an innovation and work together to customize it for their particular setting (Senge 1990). Mutual adaptation enables external groups to champion an idea that they regard as beneficial to student learning but that might not have many internal champions.

The social movement model of change suggests that when people across varying sites decide to embrace a reform or innovation, they form networks, deliberate and discuss the innovation, work collectively, and ultimately create rewards and institutional structures to make it part of the system (Palmer 1992). This type of process works best when the implementation must confront an entrenched status quo, despite the presence of many internal champions. As flexible, context-based models for achieving broad implementation, mutual adaptation and social movement both create ownership, respond to local cultures and structures, and foster deliberation and network creation. Leaders seeking to scale up pedagogical innovations should focus on three key components of both mutual adaptation and social movement models: (1) deliberation and discussion, (2) networks, and (3) external support and incentives. (Table 1 summarizes these three key components of mutual adaptation and social movement models, and indicates whether they respond to the critiques of traditional scale-up models.)

Studies have shown that deliberation and discussion among professionals commonly lead to authentic change. Several of these studies have also shown that one of the main reasons change does not occur is that people fundamentally do not understand either the reason for a proposed change or the content of it. Therefore, it is essential that people be given opportunities to engage in ongoing discussion within the context of a deliberative learning process that helps them understand the necessity for change. Through such discussion, underlying norms and values can be changed, and people can come to accept new ways of doing things (Senge 1990). Deliberation and discussion can be used to address many of the challenges of scale-up. Those who undergo a deliberative learning process are likely to develop a sense of ownership, for example, and ongoing discussion can foster internal motivation. Organizations are not static, and organizational cultures can differ widely. One benefit of deliberation and discussion is that their inherent flexibility allows for adaptation during the implementation process in response to the changing needs of particular organizational contexts.

About Project Kaleidoscope

Since its founding in 1989, Project Kaleidoscope (PKAL) has been a leading advocate for building and sustaining strong undergraduate programs in the fields of science, technology, engineering, and mathematics (STEM). With an extensive network of over seven thousand faculty members and administrators at over one thousand colleges, universities, and organizations.

PKAL has developed far-reaching influence in shaping undergraduate STEM learning environments that attract and retain undergraduate students. PKAL accomplishes its work by engaging campus faculty and leaders in funded projects, national and regional meetings, community-building activities, leadership development programs, and publications that are focused on advancing what works in STEM education.

In 2008, the Association of American Colleges and Universities (AAC&U) and PKAL announced a partnership to align and advance the work of both organizations in fostering meaningful twenty-first-century liberal education experiences for all undergraduate students, across all disciplines. This new partnership represents a natural progression, as nearly 75 percent of campuses with PKAL community members are also AAC&U member institutions. Together, AAC&U and PKAL apply their collective expertise in undergraduate learning, assessment, leadership, and institutional change to accelerate the pace and reach of STEM transformation.

For more information, visit www.aacu.org/pkal.
Networks connect people with similar ideas and provide change agents with the information and moral support they need to help move the change process along and sustain it over time. Moreover, the incentives provided by external networks can help compensate for a lack of internal incentives and support for innovation. Isolated individuals or groups are often unable to sustain change in the face of the status quo. By relieving isolation through connection with others engaged in similar efforts, networks offer a way to overcome this challenge. And discussions within such networks can help change agents adapt their strategies to context issues as they emerge.

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<th>Networks</th>
<th>External support and incentives</th>
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Networks can be created both on and off campus. In seeking to change pedagogical practices, it is especially important to link up the individuals on campus who share an interest in the new pedagogical approach. Bringing people together across campus by establishing a center related to a particular change—a center on integrated technology, for example—is a strategy common to most successful mutual adaptation and social movement processes. Alternatively, an existing center on campus—a center for teaching and learning, for example—can be used to host events that bring together individuals with similar interests. An internal campus network can serve a variety of purposes: creating a coalition to support a change effort, helping people respond to local changes by fostering awareness of changes on campus, providing incentives for change, developing a communication system for spreading information necessary to implement a change, helping sustain the change over the long term as whole sets of people are connected to the initiative, providing expertise to brainstorm problems, and supplying human resources where they are needed.

**External supports and incentives** help motivate and sustain change agents in the face of entropy and even negative dynamics by providing funding, awards, and recognition. Endorsements and other forms of support from government agencies, foundations, and other influential organizations—e.g., accreditors, disciplinary societies, community organizations—can facilitate change and help achieve scale.

Endorsements can also make it easier to move beyond the true believers, to reach other faculty and staff who may need additional external motivation before fully embracing change. The innovation gains legitimacy through endorsements and support. In addition, some external levers can be used to contribute directly to sustainability by incorporating the change into a larger system of accountability.

One way to provide more systemic support and incentives is to establish a dedicated intermediary organization—i.e., an organization whose singular mission is to support and advance a particular reform or innovation. Such an organization is able to dedicate the bulk of its efforts to the priorities of the change, something a campus alone may not be able to do. Although charismatic leaders do occasionally emerge to champion a change on campus, colleges have multiple priorities and typically cannot provide the leadership needed to scale up a change. A more systematic approach that leads to the broad and successful implementation of an innovation is to obtain support from an external organization that is dedicated to advancing the particular reform. Intermediary organizations can provide vision, rationale, access to networks and communities of practice, technical support, established awards, and other resources. They can also provide legitimacy and credibility to campus initiatives, enabling leaders on campus to point to a national organization that supports their innovation.

**This new approach exemplified**

Rather than focusing on the development, testing, and dissemination of innovations—areas of focus that are inherent in traditional scale-up models—we need greater attention to
professional dialogues and networks, incentive schemes, funding and seed money, professional norms, and the infrastructure of support. This new approach is exemplified in the most recent initiative of Project Kaleidoscope (PKAL), a national intermediary organization that has been dedicated since 1989 to supporting and advancing reform and innovation in undergraduate programs in the fields of science, technology, engineering, and mathematics. In this initiative, called Facilitating Interdisciplinary Learning, PKAL brought together twenty-eight campuses over three years in roundtables, conferences, webinars, and conference calls in order to encourage deliberation and networking.

The campuses exchanged ideas about strategies to advance interdisciplinary learning, wrestled with and vented about barriers, grappled with developing a common language for interdisciplinarity, and shared ideas for advancing campus change. PKAL’s facilitation of deliberation enabled conversations that would not naturally occur on campuses, and it afforded time for reflection—a rarity as people get caught up in their day-to-day work. Participants in the network discovered new ideas that would not have occurred to them in isolation on their own campuses. They also borrowed guidelines for interdisciplinary hiring and curriculum committee formation. Campus teams learned to frame their work in ways that are more acceptable to faculty with a strong disciplinary background. Through participation in PKAL’s annual leadership institute and a project-specific leadership conference, faculty explored their role as leaders and change agents on campus, and developed strategies to foster change by creating new professional norms and on-campus coalitions for change. PKAL provided external incentives and support by reviewing campus grant proposals, by communicating directly with each campus president and various senior administrators about the importance of the project and the need for administrative support, and by connecting project campuses to other PKAL initiatives, networks, and dissemination mechanisms (national publications and conferences). Through these types of interactions and activities, PKAL facilitated mutual adaptation and social movement, which is difficult for a campus to do on its own without support.

In conclusion, campus leaders should think more systemically about change—not just about which intervention to adopt—and they should look beyond their own campus structures to intermediary organizations like PKAL for support.

References


Adrianna Kezar is associate professor for higher education at the University of Southern California. This article has been adapted from an earlier, longer article on the topic published in *Innovative Higher Education* in February 2011.
Propagating and Realizing Educational Innovations in the System of Undergraduate STEM Education

A White Paper Commissioned for the Characterizing the Impact of Diffusion of Engineering Education Innovations Forum February 7-8, 2011

Jeffrey E. Froyd, Director of Faculty Climate and Development, Office of the Dean of Faculties and Associate Provost, Texas A&M University

Introduction

Since innovation refers to a component, device, system, process, or practice that is different from existing components, devices, systems, processes, or practices, productive examination of innovation in any field requires some effort to establish what is considered existing set of components, devices, systems, processes, or practices. Therefore, a white paper on propagation and realization of educational innovations must establish some foundation, baseline, starting point, and/or context as a background for conversations about innovation. Further, the term innovation, as frequently used today, suggests it addresses some need; therefore, it seems reasonable to ask about needs for educational innovations to address. Finally, innovators in engineering and science draw upon vast scientific, engineering, legal, economic, marketing, and many other knowledge bases to guide implementation of the processes through which they generate innovations. Innovators creating educational innovations in undergraduate STEM education should be able to draw up similar knowledge bases. The following assertions about undergraduate science, technology, engineering, and mathematics (STEM) education are offered to understand current practice with respect to these three points before directly addressing the four questions about innovation in undergraduate STEM education that were posed in the commission of the white paper. These assertions are offered in response to questions that are related to innovation.

(1) What are pervasive practices in undergraduate STEM education? As a baseline, teaching practices described below will be referred to as pervasive practices in undergraduate STEM education. If these are a baseline, then educational innovations could be described as practices that are different from these. Sometimes, these pervasive practices are summarily characterized by the phrase “teaching as you have been taught”. Of course, standard cautions apply because many faculty members teach many courses that deviate in one or more ways from these practices, so pervasive is not meant to imply universal. Also, pervasive is not meant to imply ineffective; millions of students have graduated from institutions in which these pervasive practices are employed, and the vast majority of these students have made contributions to employers and society. Furthermore, there are many practices that might be added to the list of pervasive practices, including those related to undergraduate advising and faculty development.

   a. Classroom practice: The faculty member lectures about one or more topics relevant to the course to a room full of students for the vast majority of the classroom period. The remainder of the classroom period is used for course and classroom management, e.g., announcements about upcoming due dates and exams, returning exams, announcing procedures by which exams may be picked up, and describing course policies and procedures.

   b. Course design and implementation practice: The faculty member, based on her/his domain expertise, decides on the set of topics to be covered in the course, arranges the topics in a logical order often using prerequisite knowledge as a principle for
organization. Often, choice of these topics is influenced by expectations from downstream courses that list the course under consideration as a prerequisite course. Examinations are given at the end of the course and at a small number of intermediate times.

c. Curricular design and implementation practice: Each college or university has a set of requirements that every curriculum certified by the institution must satisfy. Beyond these constraints, a department selects a mixture of required and elective courses based on the past curricula and the motives and expertise of the faculty members. In designing these curricula, content coverage, to the extent judged important by the departmental faculty has been a primary criterion. Program outcomes, required for accreditation by ABET for engineering programs, but less rigorously defined in other STEM fields, are incorporated as a necessary add-on.

(2) Is there a need? Based solely on analyses of national reports (National Academy of Engineering, 2004, 2005; National Research Council, 1999, 2003a, 2003b, 2003c, 2005; National Science Board, 1986; National Science Foundation, 1992, 1996) on undergraduate STEM education, there appears to be universal agreement that if systemic changes are not made to the pervasive practices mentioned previously, then expectations for improved student learning, increased enrollment in STEM disciplines, and student graduation rates in STEM disciplines will not be achieved. While the degree to which STEM faculty members across the United States agree with this assertion is not well understood, there is some reason to think that a majority would not support this assertion. Research on the degree of the support for the assertion as well as reasons offered for either supporting or contending with the assertion might shed additional light processes associated with adaptation of innovations in undergraduate STEM education.

(3) Is there a research base to support innovation in undergraduate STEM education? There is a substantial body of literature in the interdisciplinary field of STEM education at the undergraduate level on classroom, course, and curricular design and implication practices that offer alternatives to the aforementioned pervasive practices. The Board of Science Education (BOSE) of the National Academy of Science (NAS) is conducting a study on disciplinary-based educational research (DBER) and has commissioned a series of white papers on educational research in several STEM disciplines. Publication and analyses of these white papers might provide a clearer picture of the research base that exists to support innovation in undergraduate STEM education. In addition to the research in general supporting innovation in undergraduate STEM education, there is a literature base on practices that offer alternatives to the pervasive practices presented above. Depending on how these alternative practices are identified and classified, the list could be very long or might fit on a single page. Many of these practices could be labeled as innovations, but some people might question that label for some practices since they have been used, in some cases, for many years. It is not the intent of this white paper to present yet another summary or synthesis of the research base that already exists to support innovation in undergraduate STEM education.

As commissioned, this white paper intends to address both realization and propagation of educational innovations. As will be suggested below, there are indications that there is not a serious deficiency in the number of innovations that have been generated in the past twenty years. However, as the consensus of national reports suggests, these innovations have not systemically influenced undergraduate education in any one of the STEM disciplines. This cursory and preliminary analysis suggests that increasing likelihood of systemic change in undergraduate education in one or more of the STEM disciplines depends more on understanding how innovations are propagated and then acting on this
understanding than on greater understanding of processes for realization of educational innovations. For this reason, questions about propagation of educational innovations will be addressed first.

**Propagation of Education Innovations in Undergraduate STEM Education**

For engineers and scientists familiar with applications of diffusion in their work, the phrase “diffusion of educational innovations” may be confusing. Diffusion in engineering and scientific applications refers to transfer of mass due to a concentration gradient, i.e., mass of a particular species moves from a region of higher concentration to a region of lower concentration. Further, mass is a conserved quantity so when mass is transferred from region A to region B, region A ends up with less mass and region B with more. Educational innovations do not behave according to either the principle of conservation or the principle of concentration gradients. For example, if someone who has not adopted the innovation decides to adopt the innovation, one or more current users of the innovation do not have to forfeit application of the innovation. Also, propagation of educational innovations depends more critically on decisions by faculty members who, at some point in time, are not using the innovation about whether they will investigate the nature of the innovation and whether they will begin using the innovation, of course modified by the beliefs, preferences, and experiences of the adapting faculty members. In this way, educational innovations are not adopted, they are adapted. As a result, educational innovations may not behave in ways that characterize diffusion of mass. Since the phrase “diffusion of educational innovations” may summon, consciously or unconsciously, mental models about diffusion of mass, the phrase will be avoided in this paper. In its place, the phrase “propagation of educational innovations” will be used. It is unlikely that use of this phrase in this paper will influence the general conversation about movement of education innovations.

For this white paper, two questions have been posed about propagation of educational innovations:

1. What are possible human, organizational, and resource factors affecting propagation of educational innovations?
2. What are possible metrics by which to measure propagation of educational innovations?

Each question will be explored in the following sections.

**Factors Influencing Propagation of Educational Innovations**

The starting point for addressing the question about factors influencing propagation of education innovations would be the work by Rogers (2003). In the seminal synthesis of the research on propagation of innovations, factors that Rogers identified as influencing the extent and rapidity with which innovations spread might be grouped into three sets:

- Perceived attributes of the innovation, i.e., how do potential innovation adapters perceive the innovation?
- Characterization of the environment or context in which potential adapters of innovations learn about innovations and make decisions with respect to innovations, i.e., what is known about how potential adapters are influenced by their environment?
- Extent of change agents’ promotion efforts, i.e., what are the approaches that change agents use to promote innovations and how much energy and resources are invested in the promotion efforts?

Each of the three factors will be explored in the following paragraphs.

There are many attributes of an innovation that potential adapters might consider as they learn about it and make decisions regarding future actions. Here, continuing to draw from the work of Rogers (2003) and including the synthesis by Wejnert (2002), three are emphasized.
• Compatibility “refers to consistency of the innovation with values, experiences and needs of potential adapters” (Borrego, Froyd, & Hall, 2010).
• Complexity “refers to the perceived (or actual) difficulty of adopting the innovation. Some innovations ... can be adopted by a single faculty member, while others require coordination across departments and other academic units. Rogers explains that the higher the perceived complexity of an innovation, the lower its rate of adoption” (Borrego et al., 2010). Complexity also includes anticipated or perceived student resistance to adoption of a new approach to teaching (Cooper, MacGregor, Smith, & Robinson, 2000; Felder & Brent, 1996; Keeney-Kennicutt, Gunersel, & Simpson, 2008).
• Under perceived attributes, the phrase “perceived benefits” of the innovation refers to potential adapters’ perceptions of the advantages of adapting the innovation. For faculty members, adapting an educational innovation influence one or more of the following areas:
  • Perceptions of the responsibility of teaching, e.g., adaptation of an educational innovation may make teaching more enjoyable or more fun (Foundation Coalition, 2002; National Institute for Science Education, 1997).
  • Perceptions of changes in the time required for teaching, e.g., adaptation of an educational innovation may save faculty members time or may require more time (Henderson & Dancy, 2007). Research by Sunal and others showed that faculty in their survey, which asked respondents to identify barriers to change, ranked “resources, time, and turf conflicts” as “very important” 60% of the time (Sunal et al., 2001).
  • Improvements in students’ perception of the classroom and/or course
  • Improvements in student learning. The literature for many educational innovations includes studies showing improvements in student learning (for example, Froyd, 2008; Hoffman, Hosokawa, Blake, Headrick, & Johnson, 2006; Lewis & Lewis, 2005; Prince, 2004; Springer, Stanne, & Donovan, 1999; Tien, Roth, & Kampmeier, 2001). However, faculty members offer many reasons to discount the research showing connections between changes in educational practice and improved learning. These include: “The study was done in field X and I teach field Y.”, “The study was done at an institution that is different than the one I teach at.”, “The study did not sufficient control for other variables that may explain findings.”, and “I am skeptical about findings from educational research.” (Borrego et al., 2010).

Interactions between potential adapters and the context and environment are very complex. Again, the work by Rogers provides guidance in selecting more specific opportunities for focus:
  • Type of innovation-decision: “The type of adoption decision can be optional, collective or authority. Many engineering education innovation adoption decisions are optional among faculty members, particularly those that take place in one course in one department. Adoption of more complex innovations, in this case those requiring coordination across academic units, may need to be a combination of collective and authority decisions. Authority decisions can be made more rapidly than collective decisions, but may be undermined in actual implementation, while collective decisions may lead to embodiments of an innovation that may be sustained” (Borrego et al., 2010)
  • Local Factors: Dancy and Henderson (Henderson & Dancy, 2007), through interviews with physics faculty, some of whom had beliefs that were aligned with theories emerging from physics education research, but had not adopted research-supported pedagogies, found several structural barriers to adoption of research-supported pedagogies. These included anticipated resistance from students, the one-size-fits-all schedule of courses that meet three fixed-length...
times a week for a semester, amount of material that is expected to be covered in a single
course, department norms that support traditional approaches, and lack of time (see above).
Student resistance to pedagogies that expect more active participation in class has been
reported elsewhere (Cooper et al., 2000; Felder & Brent, 1996). Cooper et al. (2000) offer the
following strategies to address anticipated student resistance: clarify changing expectations
before and during implementation of new strategies, create meaningful activities that
encourage students to process information in different ways and yet that are at an appropriate
level of difficulty and complexity, and clarify expectations for each learning activity. Felder and
Brent (1996) list several student complaints about innovative pedagogies and offer ways in
which faculty members might address each area of resistance. Felder and Brent (1999b) cite
content coverage as a frequently asked question in their workshops on effective teaching and
offered one way to address this issue: put significant material that you would cover in lecture
into class handouts and announce that you will not go over in detail material in the handouts,
but that students are responsible for material in the handouts (Felder & Brent, 1999b). This is
one way to cover material and create class time for alternative activities that may lead to
deeper learning. In a series on frequently asked questions, Felder and Brent address several
questions that faculty members raise about implementing alternative pedagogies: where is the
evidence that they work (Felder & Brent, 1999a), content coverage (Felder & Brent, 1999b),
large classes (Felder & Brent, 1999b), group work and distance learning (Felder & Brent, 2001a),
student hostility to teaching methods that require them to take more responsibility for their
own learning (Felder & Brent, 2001b), low student motivation (Felder & Brent, 2001b), how to
design fair tests (Felder & Brent, 2002), evaluating teaching (Felder & Brent, 2003), and
persuading other faculty to use nontraditional methods (Felder & Brent, 2003). Finally,
department norms for instruction (Henderson & Dancy, 2007) are linked to another possible
source of resistance, lack of alignment with organizational culture (see below).

• Communication channels: “Communication channels can be mass media or interpersonal. In
engineering education, mass media includes journal articles, conference publications, and
professional society publications such as ASEE Prism. These are contrasted with interpersonal
channels, such as having an informal conversation with someone describing his or her positive
experience with an engineering education innovation. Rogers explains that mass media channels
are more important at the awareness stage, while interpersonal channels are critical at the
evaluation stage” (Borrego et al., 2010). In the study of engineering department head
perceptions of adoption of seven innovations in engineering education, department heads were
asked about how they heard about each of the seven innovations. “The most common method
was word of mouth (28%), followed closely by presentations on campus or at conferences (not
including technical professional societies) (23%). These relatively high percentages are in stark
contrast to very low rates of reading about innovations (at least initially) or hearing about them
through technical professional societies. These results indicate that engineering department
chairs are not generally engaging with engineering education literature, or not recalling it.
However, given the relatively high awareness rates, coupled with Rogers’ predictions regarding
communication channels at various stages of the adoption process, interpersonal interactions
are most likely to encourage adoption in the future” (Borrego et al., 2010).

• Culture: The culture of an institution influences success or failure of change initiatives (Kezar &
Eckel, 2002). Analysis of two different change initiatives within a single institution showed how
the initiative that led to a more sustainable curriculum aligned better with the culture of the
institution (Merton, Froyd, Clark, & Richardson, 2009). “As these examples illustrate, change
agents should ‘realize that the culture of the institution (and institutional type) affects change’
and seek a better understanding of the culture of the institution” (Froyd, Henderson et al.,
Schein (1992) portrays culture in three levels: artifacts and actions that could be observed; values and behavioral norms that are frequently mentioned by organizational leaders; and shared, underlying assumptions that are rarely mentioned, but direct decisions because they were influential in the early success of the organization. Bergquist and Pawlak (2008) assert that cultures of institutions fit into one of six types: collegial, managerial, developmental, advocacy, virtual, and tangible. These typologies may be useful for change agents (see below) in understanding the culture for a change initiative and how the initiative can be formed to align with the culture.

- Interpersonal Networks: “When two individuals share common meanings, beliefs, and mutual understandings, communication between them is more likely to be effective” (Rogers, 2003, p. 306). “This explains, for example, why engineering educators, like those in other disciplines, tend to discount the results of research studies which did not include engineering students; they desire information on settings similar to their own (Lattuca & Stark, 1995; Wankat, Felder, Smith, & Oreovicz, 2002)” (Borrego et al., 2010).

The final set of factors describes the nature of efforts by one or more change agents to promote one or more innovations. One question that could be raised in connection with this set of factors is: Who are the change agents? Across the communities connected with undergraduate STEM education, there are multiple answers. In order to reduce, the breadth and complexity of the communities to be considered, examination of this question will be restricted to communities related to one specific field with which the author is more familiar than other possibilities: undergraduate engineering education. Even within this restricted set of communities, addressing the question is complex. One set of change agents would be the individual investigators and small groups of investigators that NSF has empowered through funding their submitted proposals for research and innovation in engineering education. Another set of change agents could be companies who employ engineering graduates and who seek to improve the competencies and capabilities that engineering graduates bring. Another set of change agents would be government organizations who desire improvement in engineering education, for example, NSF. Still another set of change agents would be non-governmental organizations seeking the same goal. A primary example of this category of change agents would be ABET. A very visible example of change that has occurred in engineering education over the past twenty years would be replacement of process-based criteria that ABET used to accredit engineering programs in 1990 to the outcomes-based criteria that are used for accreditation in 2010. Different categories of change agents will bring different capabilities, resources, and constraints to challenges of catalyzing change in engineering education. It appears difficult to offer further description of nature of the efforts by change agents without clarifying which category of change agents are being considered.

Another set of issues that change agents must address is articulation of ends or goals for their change initiatives. As a starting point for exploration of the nature of these goals, consider the criteria that NSF has used in evaluation proposals related to innovations in undergraduate STEM education. These programs have included the Course, Curriculum, and Laboratory Improvement (CCLI) program, the Innovations in Engineering Education, Curriculum, and Infrastructure (IEECI) program, and the TUES program. In evaluating proposals for these and other programs, one or more of the criteria relate to what has traditionally been referred to as the dissemination plan. In a dissemination plan, based on the definition of dissemination, the end envisioned is greater awareness across a broad, vaguely defined community of the funded educational innovation. Approaches used in many dissemination plans have included conference papers, archival journal papers, and web sites. As mentioned earlier, Rogers (2003) has shown that these mass media approaches tend to be effective in increasing awareness, but different, more interpersonal approaches, are required to facilitate transitions to stages beyond
awareness. Concerns have been raised about effectiveness of dissemination plans, but since the end envisioned by dissemination plans is awareness, concerns may be unfounded. In a survey of engineering department heads regarding seven innovations in engineering education, awareness among the respondents was at least 60% and reached as high as 96% (Borrego et al., 2010). If awareness is the envisioned end, then the end could be said to have been realized, at least in the case of the seven innovations studies in the project. As was stated above, different categories of change agents will face different issues to determining goals for their change initiatives.

However, awareness may be just the first step in Rogers' (Rogers, 2003) sequence of adoption stages. If, for funded proposals, change agents are expected to influence decisions of potential adapters with respect to stages beyond adoption (Froyd, 2001), then re-examination of ends of dissemination plans is warranted. Clarity of the expected ends or goals is critical, because plans are made to achieve ends. If envisioned ends are inaccurate or vague, then plans made to achieve these ends may be without value. If the envision ends include greater adaptation of education innovations across a community of STEM educators, then influencing decisions made by potential adapters in stages of adoption beyond awareness becomes an important consideration for change agents. In this case, if change is the goal, Froyd and others have highlighted the importance of goals when formulating dissemination or change plans (Froyd, Beach, Henderson, & Finkelstein, 2008; Froyd, Henderson et al., 2008; Froyd, Layne, & Watson, 2006). Another consideration is the nature of the innovation to be adapted. For example, is it expected that, within a community of STEM educators, faculty members will be adapting a specific educational innovation, for example, peer-led team learning (PLTL) (Tien et al., 2001) in general chemistry? Or is the goal, for example, movement of faculty members teaching chemistry away from lecture and toward anyone of a set of innovations? Is adaptation of a particular innovation critical, or is adaptation of an innovation or combination of innovations from a large set satisfactory? The distinction is critical. Henderson, Finkelstein, and Beach, in their study of change initiatives in higher education, use the answer to these two questions, or questions similar to these questions, to partition the change strategies they found into two subsets: prescribed outcomes in which “the change agent knows upon initiating a change process what kind of behavior or mental states in individuals or groups are expected and sought, driven by the assumption that the change agent has the key knowledge needed to define the outcomes” and emergent outcomes in which “the end state in terms of behaviors or mental states are determined as part of change process, with the assumption that those involved in the change have important information needed to define the outcomes” (Henderson, Finkelstein, & Beach, 2010). Without clarity regarding expectations for ends of efforts by change agents, no progress can be made in recommending strategies that should be considered or in evaluating efficacy of the efforts by change agents.

Another set of questions that change agents must address in formulating their plans and allocating their resources related to decisions is who should be influenced. Without careful consideration and articulation of a chosen audience for influence, change agents risk spreading their efforts over the very large engineering education enterprise with no perceptible results. Given the diversity of change agents and their aspirations, at this point, the most informative statement that the author can make is that change agents must make thoughtful decisions about sizes and positions of individuals and organizations that they intend to influence.

Another set of decisions for change agents to achieve their goals involves answering questions like, “What will change in order to achieve the goals?” One example of a choice that a change agent might make for this set of decisions is whether the intent will be to change the curriculum of a course or set of courses or to change faculty members who teach the course. So, for example, an initiative to improve
first-year retention of engineering students might select to alter either the first-year engineering course or courses. However, if course changes are desired, it is necessary to ask, “What is going to be changed in the first-year courses?” Are changes in the catalog description sufficient? Are changes in the course syllabus or syllabi sufficient? Are changes in the way the course is taught, e.g., active/cooperative learning or problem-based learning, sufficient? Felder et al. list seven well-supported improvements to teaching practice: (1) formulate and publish clear instructional objectives, (2) establish relevance of course material and teach inductively, (3) balance concrete and abstract information in every course, (4) promote active learning in the classroom, (5) use cooperative learning, (6) give challenging but fair tests, and (7) convey a sense of concern about students’ learning (Felder, Woods, Stice, & Rugarcia, 2000). Suppose one instructor who teaches the course makes changes to the course content and the way the course is taught. Next year, another instructor who teaches the course decides that the content and pedagogical changes are not justified and teaches the course as it was taught before the changes. Is the course changed? Curricula and courses are outward manifestations of how faculty members think about learning, assessment, and teaching. If conceptions of faculty members regarding learning, assessment, and teaching are not changed, it seems reasonable to ask how much paper changes to curricula and courses, e.g., catalog descriptions and ABET course syllabi, will achieve the espoused goals. These are questions that were addressed by Woodbury and Gess-Newsome in their study of change in college science courses (Gess-Newsome, Southerland, Johnston, & Woodbury, 2003; Woodbury & Gess-Newsome, 2002). They concluded that curricula and course changes often resulted in what they labeled “change without difference” (Woodbury & Gess-Newsome, 2002). Instead, they called for “focus on encouraging and supporting change in teachers’ work as the center of reform efforts” (Woodbury & Gess-Newsome, 2002). This reinforces the importance of “staff development” as one of five key factors identified by Eckel and Kezar (Eckel & Kezar, 2003) that support successful transformations. So, in many cases, change initiatives that were initially conceptualized as curriculum development become faculty development initiatives (Clark, Froyd, Merton, & Richardson, 2004).

Possible Metrics for Measuring Propagation of Educational Innovations
Determinationg the extent to which an educational innovation has propagated across a particular STEM discipline education community appears, at first glance, straightforward, although perhaps not easy. A survey could ask faculty members in the community about whether they are using a particular innovation. However, unlike artifacts (e.g., TVs, cell phones, toaster ovens...), referring to educational practices assumes a common vocabulary about these practices across the community. It is likely that many engineering faculty members, for example, have not heard about process oriented, guided inquiry learning (POGIL), so if they are asked if they are using POGIL-based practices, the likely response is no, even if their instructional practices conform to many of the guidelines advocated by this educational practice. Further, getting response rates to national surveys of STEM discipline education communities up to levels at which survey results can be truly meaningful indicators of the extent to which an innovation has propagated can be problematic (Borrego et al., 2010). Beyond these issues is the question of whether the community values knowledge of the extent to which a particular innovation has propagated. Of more interest may be the extent to which a set of educational innovations, classified into the set because they met some similarity criteria, has influenced practice across the community. If this is the question, the determination of the set becomes an issue to be resolved. If and when knowledge of the propagation of a set of innovations is determined, then questions about how and why the set of innovations propagated (or failed to do so), and the conversation returns to the question about the factors that influence propagation of education innovations in undergraduate STEM education.
Realization of Education Innovations in Undergraduate STEM Education

Realization of educational innovations in undergraduate STEM education is defined, for the purpose of this white paper, to be the generation of educational practices that are different from the set of pervasive practices described in the introduction. In engineering education, as mentioned in the introduction, there are at least two conferences each year, the ASEE Annual Conference & Exposition and the Frontiers in Education (FIE) Conference, at which attendees present innovative practices. Other STEM disciplines are likely to be able to report similar observations. The number of papers presented at these conferences and the numbers of attendees suggest that there is no lack of innovative practices being generated. Another report states that “[f]aculty members routinely change their courses from semester to semester, experimenting with both minor changes and major innovations, according to a national survey released Saturday by the Bringing Theory to Practice program. But while professors see curricular innovation as part of their jobs, they remain uncertain about whether pedagogical efforts are appropriately rewarded, the study found” (Inside Higher Ed, 2010). So it appears that there is constant generation of innovation in undergraduate STEM education. Given this situation, why would questions be raised about realization of innovations in undergraduate STEM education?

At least four issues might be raised about the observation of ubiquity of generation of educational innovations in the previous paragraph:

- First, when one faculty member does something different in her/his course than the last time she/he taught the same course, does qualify as an educational innovation? Is there a lower bound on the number of faculty members using a particular practice to qualify as an educational innovation?

- Second, when one faculty member does something different, but it is very similar to what another faculty member has done, does that qualify as an educational innovation? If a faculty member in physics decides to use the Peer Instruction approach described by Eric Mazur (Mazur, 1997) that she/he has never used before, does this qualify as an educational innovation? Suppose the disciplinary boundary is crossed, i.e., suppose a chemist was the first to use the Peer Instruction approach in any undergraduate chemistry course, does this qualify as an educational innovation? Questions have been raised about the degree to which ideas presented in conference papers and proposals to the NSF program in Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics (TUES) might be categorized as innovations. One reason might be because of the degree to which they resemble already published practices, while another reason might be because of the degree to which the authors have applied prior work in making their design decisions that resulted in the presented practice. The question might be posed another way: When a faculty member does something different for her/his course, but the practice is similar to what another faculty member already has done, is this realization of an innovation or propagation of an innovation?

- Third, does a practice that is different from the pervasive practices described above have to be based on a body of research to qualify as an educational innovation? Another reason that questions might be raised about whether a different approach that a faculty member tries in her/his course qualifies as an innovation is to what extent the approach draws upon the existing body of knowledge to inform decisions that led to the approach. Is the faculty member just making things up as she/he teaches the course. The ASEE report (Jamieson & Lohmann, 2009) co-shepherded by Leah Jamieson and Jack Lohmann refers to tendencies by engineering faculty members to develop alternative practices based almost completely based on intuition and trial-and-error, as opposed to also drawing upon published scholarship. Thus, for engineering faculty members, they fail to apply engineering processes, such as engineering design processes, to
creation, design, implementation, and operation of their engineering courses. Further, there are
tendencies to classify as innovations some practices simply because they represent early
adoption in a particular discipline, while the practice may have been underway for some length
of time and by a number of practitioners in another discipline. The author is unaware of similar
reports in other STEM disciplines.

- Fourth, does a practice that is different from the pervasive practices described above have to be
supported by a body of evidence supporting its efficacy in achieving stated goals to be
categorized as an innovation?

At this point, it does not appear that there is not a need to improve the number of educational
innovations in undergraduate STEM education, nor is there a need to improve the processes associated
with realization of education innovations. So, further exploration of the factors associated with
realization of educational innovations and metrics associated with realization will be postponed until
there is sufficient understanding of the issues associated with realization.

Conclusions

Many studies, several of which could be considered seminal, offer factors that influence how
educational innovations propagate across communities that support undergraduate STEM education
(Borrego et al., 2010; Eckel & Kezar, 2003; Froyd et al., 2006; Henderson et al., 2010; Kezar & Eckel,
2002; Rogers, 2003; Schein, 1992; Senge et al., 1999; Wejnert, 2002; Woodbury & Gess-Newsome,
2002). People and organizations who accept responsibility for influencing practices across the spectrum
of undergraduate STEM education activities have been referred to as change agents. Their efforts play a
pivotal role in propagation of educational innovations.

One of the challenges that these change agents face is applying the knowledge base on propagation of
educational innovations to create actions that are likely to catalyze and maintain sustained, systemic
improvement (Froyd & Watson, 2000) in undergraduate STEM education. Given the complexity of
factors influencing propagation and the time scales over which effects of sustained propagation will
become visible, concerns might be raised about, not importance or criticality, but visibility and ability to
observe consequences of individual change agents working for one, two, or three years. As an example
of visible, systemic change in a set of STEM disciplines, namely engineering, the shift in accreditation
criteria to emphasize articulation, assessment, and application of educational objectives and outcomes
has influenced the practice of undergraduate engineering education at a national scale. Questions may
be raised about the degree to which the practice of individual engineering faculty members has changed
as a result of the shift in accreditation criteria. However, it is unlikely that questions could be raised
about the scope and systemic nature of the change. Incorporating educational outcomes as a core
element of accreditation has taken twenty years and involvement of at least hundreds of individuals and
organizations. If shifts of similar or greater scope are expected in undergraduate STEM education across
all its disciplines, similar time periods may be expected if sufficient individuals and organizations are
willing to commit. Resources on a scale that matches the immensity of the challenge may accelerate a
national movement, but that has not been demonstrated. Given the size of the resources that the
United States has been willing to commit to the realization and propagation of educational innovations
over the last 20 years and uncertainty about the degree to which a change will be accelerated, it is
unlikely sufficient investment will be made.

References


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Jane Wellman is the Executive Director of the Delta Project on Postsecondary Costs, Productivity and Accountability, a non-profit research and policy organization located in Washington, DC. The Delta Project’s mission is to improve productivity in higher education through better targeting of resources to protect student access and the quality of student learning. Wellman is recognized for her work in public policy and higher education, at both the state and federal levels, with particular expertise in state fiscal policy; cost analysis; strategic planning; state and federal regulation of higher education; accountability metrics and performance reporting; and quality control including accreditation. Her career spans work in public institutions, state as well as federal government, and with private not-for-profit as well as for-profit institutions. She is a widely published policy analyst, and a frequent consultant both in this country and internationally, to institutions, state governments, public policy organizations and foundations. She is a member of the Association of Governing Boards Consulting Services, and serves on the boards of the Association of American Colleges and Universities as well as Argosy University.

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Abstract

Connecting the Dots Between Learning and Resources

American higher education is being challenged as never before by the imperative to increase postsecondary access and degree attainment despite declines in funding. The challenge is made all the more daunting because of the rapid changes in student demographics. Meeting these challenges without harming quality will require unprecedented attention to the intersection of resource use and performance. Almost every institution is currently struggling to find ways to restructure its costs, a painful exercise that requires hard thinking about priorities and spending. Institutional and policy leaders are asking for guidance, and for data that tells them something about how to focus scarce resources in areas that make the biggest difference in access, attainment, and learning outcomes.

They’re not getting much help: despite nearly two decades of increased attention to learning assessments, we have yet to cross the rubicon of connecting the dots between educational practices that promote student learning with the way that funds are used. For all the good work that has been done in the assessment of student learning, little parallel attention has been given to questions of cost-effectiveness and to the difference that money either does or does not make in getting students to degrees with acceptable levels of learning. Conventional assumptions about college finances, including the assumption that more money means better quality, appear to be so commonly held that they are not seriously analyzed by institutions or addressed by researchers. The problem occurs on both sides of the equation, with not enough attention in work on student success to clear measures of learning outcomes and not enough attention on the cost side to the connection between spending levels or patterns and student academic success.

To get a better handle on what is known and the much that remains to be discovered, this paper presents a conceptual approach for analyzing the relation of spending to student success, followed by an examination of what the existing research says about the topic. Since there is so little work directly on the topic of learning and resource use, this paper searches other areas of work for threads that might be sturdy enough to be woven into a fabric of knowledge about learning and resources. The paper concludes by recapping the research themes and by suggesting directions for future work.
In February 2009, President Obama called upon the nation’s colleges and universities to significantly increase the proportion of citizens with a postsecondary credential. Reaching this goal will be especially challenging under the best of conditions and even more difficult because the current recession has significantly reduced the amount of resources available to colleges and universities. One essential step will be for the academy to better understand the relationships between costs and such outcomes as degrees earned and enhanced levels of learning. These relationships have always been obscure for higher education. When college leaders are asked how much money they need to operate, the typical response is “more” or “as much as our peers.” Little serious consideration usually is given to how much of what kind of resource does the institution require to reach or maintain a given level of output or performance.

No one is better qualified than Jane Wellman to chart this territory. As leader of the Delta Cost Project, she has focused extensively on the costs of higher education for the past two years. And in a long and distinguished career as a policy analyst at the state and national level she has advised on policies and projects as varied as planning and resource allocation to accreditation and quality assurance.

The first thing needed for so vast an undertaking is a conceptual scheme to describe the many ingredients of cost, the equally varied range of postsecondary outcomes, and the potential relationships between them. This is necessary in part because the literature on higher education productivity is itself so varied. The distinct bodies of work that Wellman then reviews in the light of this conceptual scheme include theoretical treatments of costs, empirical work on institutional cost patterns, survey work on perceptions of costs by policy leaders and the general public, research connecting institutional spending and results, research on student aid and its effects, treatments of faculty teaching effectiveness, inquiries into individual and social return on investment, and work exploring the concept of “learning productivity.”

A number of important points emerge from this sweeping review. A first, somewhat surprising, observation is the relative paucity of work that actually examines postsecondary productivity. Fewer than a dozen studies Wellman reviews looked at the relationship between costs and outputs directly—a condition that begs for more attention. A second important insight is the way conclusions about cost-effectiveness can change markedly when the metric applied is not the traditional cost-per-enrollment but a measure that is far more relevant to Obama’s goal, cost-per-degree. Among the somewhat surprising conclusions of accomplishing this shift is that, contrary to popular public policy belief, community colleges are not cheap when it comes to cost-per-degree. A third leitmotif is the power of activity-based costing models in revealing—so ultimately diagnosing and restructuring—higher education’s “production function” for teaching and learning. The course redesign work of the National Center for Academic Transformation (NCAT) provides Wellman’s clearest illustration of the applications of activity-based costing, while simultaneously providing an illustration of the power of directly connecting cost calculations with assessed learning outcomes. A final important insight—again against the grain of conventional wisdom—is that simply investing more money does not appear to produce more or better outcomes. Improved student learning will occur only if such investments are directed and intentional.

Wellman thus demythologizes more than a few things that policy and institutional leaders thought they knew about the connection between costs and results. She also offers cogent advice about what further lines of inquiry should look like. In lifting some of the fog from a broad and murky landscape, she has done us all a great service.

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Connect the Dots Between Learning and Resources

Jane V. Wellman

The Challenge: Increasing Learning and Degree Attainment Despite Funding Declines

For the better part of the last 15 years, leaders in American higher education have been working to improve student success, focusing particularly on assessment of learning outcomes and getting more students to degrees. Despite frustration at the slowness of change and continued debate about learning goals and measures, most would agree that the assessment trend has taken hold—that important questions are being asked and that serious work is being done. But progress in translating good intentions into improved educational practices is at risk of being erased by another dominant trend in American higher education: eroding fiscal support, course reductions, layoffs, higher tuitions, budget cuts, and reductions in educational access.

The funding challenges facing American higher education are not going to go away soon. Although some level of revenue growth should return when the recession ends, resources will not likely return to the level of support enjoyed by previous generations (Boyd, 2009). Almost every institution is being forced to look at ways to change its cost structures, to align spending with revenues in a way that avoids permanent damage to institutional and public priorities. As part of this, leaders are asking questions about the relationship between spending and success and about how to allocate scarce resources for the greatest payoffs in student learning and degree attainment.

There’s the rub. Not much evidence exists on the relationship between resources and institutional performance, particularly as it relates to improvements in student learning and degree attainment. For all the good work that has been done in the assessment of student learning, little parallel attention has been given to questions of cost-effectiveness and to the difference that money either does or does not make in getting students to degrees with acceptable levels of learning. Conventional assumptions about college finances, including the assumption that more money means better quality, appear to be so commonly held that they are not seriously analyzed by institutions or addressed by researchers. The problem occurs on both sides of the equation, with not enough attention in work on student success to clear measures of learning outcomes and not enough attention on the cost side to the connection between spending levels or patterns and student academic success.

To get a better handle on what is known and the much that remains to be discovered, this occasional paper presents a conceptual approach for analyzing the relation of spending to student success, followed by an examination of what the existing research says about the topic. Since there is so little work directly on the topic of learning and resource use, this paper searches other areas of work for threads that might be sturdy enough to be woven into a fabric of knowledge about learning and resources. The paper concludes by recapping the research themes and by suggesting directions for future work.
A Conceptual Framework for Thinking About Cost-Effectiveness

Most measures of costs in higher education are measures either of revenues (such as tuition or state appropriations) or inputs (revenues per student or faculty salaries) rather than measures of how resources are used. Ideally, to look at cost-effectiveness, one would look at the role of funds in producing educational value added, or the translation of inputs into outputs. Such a look would require better ways to evaluate learning than are currently available as well as better ways to look at how funds are used within institutions.

In the absence of ideal measures, a number of proxies can be created that measure different dimensions of spending in relation to types of outcomes. On the cost side, variables include measures of how institutions apportion money between functions (such as between instruction and research or academics and student support) and measures of how labor resources are used, particularly for faculty and student service personnel. Cost analysis can also look at revenues to get a sense of the volume of resources available as well as the proportion of funds controlled within the institution rather than by outside funders. On the outcomes side, proxies for learning outcomes include measures of credits earned, year-to-year retention, degree or certificate completion, and lifetime earnings.

<table>
<thead>
<tr>
<th>Cost Variables</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Spending per student or total revenues from all resources</td>
<td>• Credits earned</td>
</tr>
<tr>
<td>• Spending per student from unrestricted resources only</td>
<td>• Completion of 12 units or more</td>
</tr>
<tr>
<td>• Spending per student by functional area (e.g., for instruction, student services, financial aid)</td>
<td>• First-year retention</td>
</tr>
<tr>
<td>• Spending per student for education and related expenses only (excluding sponsored research and public service and auxiliary enterprises)</td>
<td>• Degrees completed</td>
</tr>
<tr>
<td>• Trends over time in spending and by functional area</td>
<td>• Certificates completed</td>
</tr>
<tr>
<td></td>
<td>• Transfer from a two-year to a four-year institution</td>
</tr>
<tr>
<td></td>
<td>• Job placement rates</td>
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<td></td>
<td>• Pass rates on examinations such as the GRE or licensure examinations</td>
</tr>
<tr>
<td></td>
<td>• Lifetime earnings</td>
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</tbody>
</table>

Using this framework one can imagine a number of ways to connect topics on the cost side of the matrix to the outputs side, to look at spending in relation to different measures of performance. For instance, one would learn something about spending and performance by evaluating changes over time in spending for instruction in relation to rates of retention or the number of students completing 12 or more units or the number of degrees or certificates earned. These measures could be generated within a single institution or used to compare (appropriately comparable) institutions.
A Scan of the Existing Research Literature

Theoretical Work on Institutional Costs

Some of the most prominent work on higher education costs is theoretical rather than empirical, beginning with the seminal work on the service sector “cost disease” by William Baumol and William Bowen (1966), who argued that costs in the service sector inevitably rise as labor costs increase because the work in that sector cannot be made more productive without harming its quality. To make this point, they offered the example of the string quartet, which requires four instruments and four musicians and cannot be produced more cheaply by eliminating one of the parts. Taking this “cost disease” theory a step further in his early research, Howard Bowen (1980) said that higher education costs are a function of revenue availability. In his “revenue theory of college costs” he argued that in the absence of ways to evaluate quality colleges and universities tend to treat revenue as a surrogate for quality—creating an incentive structure such that institutions inevitably seek to increase revenues to expand quality, and so unless revenues dry up costs inevitably increase.

Empirical Work on Cost Patterns

Outside the theoretical work on college spending, a relatively small literature on revenue and spending patterns in higher education has produced consistent findings about the primary factors that determine costs or spending levels. Again, this work concentrates on funding patterns and inputs and not on spending in relation to any measure of outcomes. Clotfelter (1996), Winston and Zimmerman (2000), Pew Policy Perspectives (1990), Winston (2000), and Zemsky, Wegner, and Massy (2005) have all looked at revenue and spending patterns among selective private institutions and research universities and have consistently found evidence of cost growth, driven largely by competition for resources and reputation. The pattern among elite institutions is that competition increases spending, primarily because of the costs of faculty research and merit-aid for students. This was described as the phenomenon of the “academic ratchet” in the 1990 essay “The Lattice and the Ratchet” produced by the Pew Higher Education Research Program:

[The academic ratchet] is a term to describe the steady, irreversible shift of faculty allegiance away from the goals of a given institution, toward those of an academic specialty. The ratchet denotes the advance of an entrepreneurial spirit among faculty nationwide, leading to increased emphasis on research and publication, and on teaching one’s specialty in favor of general introduction courses, often at the expense of coherence in an academic curriculum. Institutions seeking to enhance their own prestige may contribute to the ratchet by reducing faculty teaching and advising responsibilities across the board, enabling faculty to pursue their individual research and publication with fewer distractions. The academic ratchet raises an institution’s costs, and it results in undergraduates paying more to attend institutions in which they receive less attention than in previous decades. (pp. 4-5)

Studies of revenue and spending patterns also show consistent and wide variations in costs depending on an institution’s mission, funding structure, and program mix (Bowen, 1980; McPherson, Schapiro, & Winston, 1993; National Commission on the Cost of Higher Education, 1999; National Center for Education Statistics, 2001). Research universities, public and
private, have the highest average costs per student, largely because faculty compensation includes funding for “departmental research” in the form of reduced teaching loads as well as higher support levels for graduate and professional education. Private nonprofit institutions on average have more revenues per student than do public institutions, principally from higher tuitions and endowments. Costs per student are typically lowest in community colleges, which are heavily dependent on state and local appropriations and where most states have kept tuition low to maximize access. Among public institutions as well as in many private research universities, undergraduate education costs are lower than upper division costs, which are lower than costs for graduate and professional education. Since most high-cost programs do not have dedicated sources of revenue to support them, they are funded through internal reallocations known as “cross-subsidies.”

The mix of programs offered by an institution also drives costs; the sciences and laboratory-based disciplines consistently require more in spending than language and literature or other humanities (Middaugh, 2002). Among the professions, the health sciences are by far the most costly, followed by engineering. Despite the relatively inexpensive instructional costs of their large class sizes, law and business have come to be expensive, because of high faculty salaries. Education, particularly teacher education, has historically been a low-cost discipline.

Many analysts argue that cost structures are determined by institutional spending priorities as much as by intrinsic requirements for spending and that these priorities often devalue undergraduate education in favor of graduate education and research (Jones & Wellman, 2009; Pew Policy Perspectives, 1990). Boyer (1990), among others, used this analysis to argue for changing the tenure reward system to recognize scholarship in teaching and learning as equivalent to research as a basis for faculty promotion.

**Studies of Public and Policy-maker Perceptions of Costs**

Opinion research shows that the public—and most policy makers—have a lopsided and somewhat inaccurate view about spending in higher education. Perhaps this is because the cost literature is so thin or because articles on elite private or research universities dominate media attention. Whatever the reason, the public thinks that institutions have much more money than they really have and for the most part that tuitions generate profits subsequently lavished on high-priced faculty and administrators. Distinctions between public and private institutions and different types of institutional missions—so central to institutional self-perception and evaluation within the academy—are invisible, or maybe just irrelevant, to the public. The public—and most policy makers—do not think about the relationship between prices and costs, and negative reactions to tuition increases have become a flashpoint for criticism about higher education spending priorities. Surveys of public perceptions about prices show that the public consistently overestimates the price of college and underestimates the availability of financial aid. Despite widespread public support for higher education and growing awareness of the importance of higher education to our country’s future, the public believes institutions are spending money in ways that further institutions’ self-interests rather than in ways that help students go to college and learn. A slight majority believes that institutions could reduce spending without hurting quality (Ikenberry & Hartle, 2000; Immerwahr, 1999; Immerwahr & Johnson, 2007).
As evidenced in surveys and other opinion research conducted with elected officials, leaders in the philanthropic community, newspaper editors, and other opinion leaders (Immewahr, 1999), the critique about college costs is even sharper among policy elites, who are inclined to think that institutions are either unwilling or unable to manage costs and that they pursue institutional prestige as a higher priority than meeting public needs. The critique that faculty workload and tenure are at the center of the “cost disease” also persists, with calls to give greater attention to cost management and productivity rather than increase funding. A letter to the U.S. Secretary of Education from Charles Miller (2006), then chairman of the Spellings Commission on the Future of Higher Education, bluntly sums up this view:

Of particular serious concern to me is the dysfunctional nature of higher education finance. In addition to the lack of transparency regarding pricing, which severely limits the price signals found in a market-based system, there is a lack of the incentives necessary to affect institutional behavior so as to reward innovation and improvement in productivity. Financial systems of higher education instead focus on and reward increasing revenues—a top line structure with no real bottom line. (p. 8A)

While his view was widely considered biased within higher education, this (to be sure) pejorative framing of the “cost disease” is not that different from the research work of Baumol, Bowen, Clotfelter, Winston, Zemsky, Wegner, and Massy. Moreover, this framing is most accurate with respect to elite institutions and institutions in the research sector—which, although clearly the ones with the most money to spend, are in the minority across the country.

**Research on Institutional Spending and Performance**

A few studies in the research literature focus squarely on spending and performance as measured by student degree attainment and effective teaching practices. Most of these are efforts to apply statistical analysis to establish causal relationships between resources and some measure of educational outcomes. Two studies by researchers Patrick Kelly and Dennis Jones, of the National Center for Higher Education Management Systems (NCHEMS), evaluate aggregate levels of education and related spending per student (e.g., excluding spending on organized research, auxiliary enterprises, and public service) in relation to degrees produced and to labor force value as measured by subsequent earnings. In the first study, Kelly and Jones (2005) looked at aggregate revenue and spending data for public institutions, organized by institutional system and state, to see whether spending makes a difference in access, in state-level degree productivity, or in research funding. Recognizing that these measures say nothing about quality, the researchers found no consistent relationship between levels of spending and any of the measures of performance. The performance of states with relatively low levels of spending per student, like Colorado, was almost identical to that of the much better funded public institutions, like the University of North Carolina, on the proportion of the adult population being served by higher education, on the number of degrees produced relative to enrollment levels, and on funding for sponsored research. Although their major finding was that funding levels overall do not explain differences in performance, Kelly and Jones found that spending on student support services does correlate with higher levels of degree attainment. Their research suggests that the way resources are used may matter as much as or more than the absolute level of funds available.

In the second study, Kelly (2009) compared the same measure of institutional spending to state-level earnings data to develop a rough measure of...
spending productivity through a translation of spending into the economic value of the degrees a college or university produces. The labor-market assessment showed wide variations in spending productivity, again with no consistent pattern across states but with interesting variations between them. The study concludes that different types of market outcomes are not explained by different spending levels and that some states produce a consistently higher return than other states on the public investment.

The Delta Cost Project has produced a data set to present periodic reviews of spending patterns across higher education and to document trends in spending in relation to different measures of results. Using a panel of roughly 1,000 public and private institutions, organized into Carnegie classifications, this database is designed to invite more researchers to look at spending in relation to different aspects of performance—a comparison that has been difficult largely because the finance data are so difficult to work with. The Delta trends report (2009) presents six aggregate measures of revenues and spending:

1) Revenues per student by source of funds, thus generating an estimate of the proportion of total revenues that are discretionary versus those that are restricted;
2) Spending per student by major area and patterns over time in the amount of spending going to different areas;
3) Spending increases measured against tuition increases to assess whether tuitions are increasing because spending is increasing or because of shifts in revenue;
4) Cost-price-subsidy measures, or average spending per student, and the proportion of spending subsidized either by the institution or the state and the amount paid for by student tuitions;
5) Education and related spending per student related to degrees or certificates attained; and
6) Education and related spending per student by sector measured against total enrollments by sector.

Most of these are measures of resource inputs rather than of performance; but the measure of spending per degree is similar to that used by Kelly and Jones. Over time, the Delta data show that costs per degree are consistently lowest among comprehensive institutions and are highest on average in research universities. The analysis also shows that in many states the costs per degree for public community colleges are actually higher than the costs per degree for public research universities. The reason for this is that community colleges, despite on average much lower spending levels, produce relatively few degrees in proportion to student enrollments. In these states, shifting more students to community colleges might reduce spending per student, but it would do so at the expense of cost-effective degree production—suggesting that states interested in increasing degrees in proportion to investments would get the most bang for the buck by shifting enrollments into the comprehensive sector.

Delta Cost Project data were also used in a study done by Cornell Higher Education Research Institute (CHERI) researchers Romano and Djajalaksana (2008), who compared spending and degree attainment patterns among community colleges with those of other public institutions to explore whether states could save on postsecondary costs by shifting enrollments from comprehensive or research institutions to community colleges. Adjusting national estimates with the Delta data, they compared community college costs to actual expenditures at four-year institutions for the first two years of bacca-
laureate instruction and then compared spending at these institutions to their levels of degree attainment or transfer. The researchers found a slight cost advantage at the public comprehensive institutions over the public community colleges.

Two other studies looked at more granular institutional spending data in relation to measures of teaching performance, both using samples of institutions identified as having effective teaching practices by the DEEP (Documenting Effective Educational Practices) project of the National Survey of Student Engagement (NSSE). In the first of these studies, NCHEMS researcher Peter Ewell (2003) looked at spending levels compared to institutional effectiveness in student engagement and retention. A sample of 20 institutions identified by NSSE as outperforming peers in student engagement and retention was created, and a peer group of similar institutions was identified that had been selected for attributes similar to the DEEP institutions (size, mission, admissions selectivity). Spending per student for instruction and related expenses was then compared between the two sets of institutions. Ewell found that the more effective institutions did not spend more per student than their peers but that they did spend differently, putting proportionately more money into academic and student support than their peers did. A follow-up study from an Iowa State University team found the same thing: total spending levels evidently mattered less to effective educational practices than did the distribution of the resources within the institution (Gansemer-Topf, Saunders, Shuh, & Shelley, 2004).

Another recent study provides additional support for the theory that student services expenses make a difference in retention and degree completion of low-income students. Using panel data developed by the Delta Cost Project, CHERI researchers Webber and Ehrenberg (2009) examined the influence of spending in instruction, student services, and other areas on the graduation and first-year persistence of undergraduate students. The strongest influence they found was from student service expenditures, with the highest marginal effects for students in institutions with low admissions selectivity and high proportions of Pell grant students. Simulations of the effect of reallocation from instruction to student services showed an enhancement of persistence and graduation.

And lastly, a new National Bureau of Economic Research study (2009), by economists John Bound with Michael Lovenheim and Sarah Turner, analyzes the influence of instructional spending and incoming student academic preparation on rates of college completion. Using data from the National Longitudinal Study of the High School Class of 1972 (NLS72) and the National Educational Longitudinal Study of 1988 (NELS:88) they document a roughly 5% decline in eight-year college completion rates between the 1972 and 1988 high school cohorts. All of the decline occurred among students who initially enrolled in either a public community college or less selective public four year institutions; graduation rates actually increased over this same time period for students in private nonprofit and public selective institutions. They then analyzed the influence of incoming academic preparation (using math test scores) and institutional spending on instruction (measured by student/faculty ratios) on graduation rates. They found that almost all of the declines in graduation rates from community college were attributable to declines in the academic preparation of entering students. However, they found that academic preparation explained almost none of the declines among the public four-year sector. Instead, for these institutions, they found deteriorating finances, measured by increasing student/faculty ratios, to account for more
than three-quarters of the change in graduation rates. This study has immediately provoked debate about whether the researchers used the correct measures for cohort graduation rates. Still, the finding about declines in spending on instruction are consistent with similar findings reported (albeit for different years) by the Delta Project’s trend reports. Since this is one of the very few studies that shows any relation between instructional spending and degree attainment, it will be important to revisit these findings with more recent spending data and more refined measures of degree completion.

Research on Student Aid

Research on student tuition and financial aid dominates most of the finance literature in higher education. Since tuition is a revenue source (and not a spending category), this research primarily addresses funding inputs and not how resources are used. Still, there are some consistent themes in the student aid research relevant to the role of student aid in increasing access and student success. One consistent finding is that achievement gaps between low-income students and other students are far higher in terms of college completions than in terms of measures at the point of initial college entry (Kane, 2004; McPherson, Schapiro, & Winston, 1993; Mortenson, 1998; Pell Institute, 2004). Most student financial aid programs, however, have access and not degree attainment as their primary goal. Work-study programs are an exception, and the research shows these programs have had some success in increasing degree persistence among low-income students. In addition to providing financial help, these work opportunities have the benefit of increasing student interaction with university staff and faculty and cultivating the student’s identity as a member of the campus community.

A second consistent finding in the research literature relates to institutional student financial aid. Institutional resources for student aid have increased rapidly, both through the use of “tuition discounts” and in grant aid. Research shows that the majority of this has gone to “merit” aid, or aid that is distributed primarily on the basis of academic merit rather than financial need (College Board, 2008). Merit aid can be helpful to campus enrollment management, but since it goes to students who would go to college without it, merit aid has no appreciable effect on increasing college access or persistence. To work toward these goals, institutions would seem to do better by spending their limited dollars either in grant aid or in work-study programs or on programs to enhance student success.

Research on Faculty and Teaching Effectiveness

As institutions work to contain costs, the use of part-time and contingent faculty has increased precipitously. The preponderance of the research literature on this topic addresses the negative impact on the professoriate itself, from lost wages and benefits to perceived loss of academic freedom. Some researchers have looked at the relationship between the use of part-time and contingent faculty and measures of student learning. Umbach (2007) surveyed faculty using data from the Faculty Survey of Student Engagement to evaluate the relationship between faculty appointment status and institutional engagement with effective teaching practices. He found that contingent, particularly part-time, status to be negatively related to faculty job performance in undergraduate education—less use of active and collaborative teaching techniques, less likelihood of challenging the students academically, less likelihood of spending time preparing for class, and less likelihood of interacting with students.
Using institution-level panel data to look at first-to-second-year persistence and graduation rates and use of part-time or nontenured full-time instructors, Ehrenberg and Zhang (2005) found that increases in nontenured and part-time faculty reduced both rates. Bettinger and Long (2004) also looked at how adjunct faculty affect student interest and course performance, using detailed data from Ohio public institutions. The Ohio study allowed matching of student unit-level data including transcripts with faculty teaching the courses, so the researchers could adjust for differences in academic preparation as well as course-taking patterns. This study found different effects depending on discipline, with an overall slight loss of student interest in the subjects for courses taken from graduate students and adjuncts compared to full-time faculty and with a slight positive effect from use of adjunct professors among disciplines with an occupational or vocational focus.

Return-on-Investment Concepts

Some of the research literature promotes the idea of using internal return-on-investment (ROI) approaches to assessing cost-effectiveness in higher education. Unlike most ROI studies—which compare costs of degree production to the earnings of college graduates or to societal benefits from higher education—internal ROI studies look at spending per student in relation to improvements in student retention. Enrollment management consultants Noel-Levitz have produced an ROI calculator to compare the costs of interventions designed to improve retention against the additional revenues from tuition and state appropriations for retained students. This calculator is posted online at https://www.noellevitz.com/Papers+and+Research/Retention+Calculator/.

Using the Noel-Levitz ROI calculator for their monograph, Investing in Quality: Tools for Improving Curricular Efficiency, prepared for the Association of American Colleges and Universities, Ann Ferren and Rick Slavings (2000) targeted academic administrators interested in finding cost-effective ways to improve student learning and identified a number of strategies for increasing academic cost-effectiveness by investing in student success, managing the curriculum, consolidating high-cost programs, and reinvesting savings in academic programs. Working with data from Radford University, they compared the costs and gains of different cost-reduction strategies and found considerably greater positive impact (in increased revenues) from increasing student retention than from such cost-cutting efforts as increasing class size or consolidating programs.

The ROI model was used most recently by the Delta Cost Project (in press) in a pilot effort with Jobs for the Future (JFF) to test the feasibility of adding costs into evaluations of student success programs. Working with a small group of institutions identified by their established track records in student success programs, Delta and JFF promoted the addition of activity-based costing measures to assessments of these programs. The hope was that this methodology could be the basis for evaluations of cost-effectiveness, including the payoff in increased retention and degree attainment. Although all of the programs had been evaluated, most of the evaluations were qualitative and not quantitative and rarely were translated into metrics such as reductions in units attempted or increases in graduation rates. Forcing the addition of costs into the assessment of effectiveness by necessity narrowed the focus of what “counts” for effectiveness to a relatively small number of dimensions that could be translated into measures of resources: courses attempted versus courses completed, number of credits obtained, proportion of students retained from one semester to the next, and degree completion. This did not mean that the

Unlike most ROI studies—which compare costs of degree production to the earnings of college graduates or to societal benefits from higher education—internal ROI studies look at spending per student in relation to improvements in student retention.
other reported types of success—such as increases in student self-esteem or even higher grades in course work—were not also important; they just were not measures that could readily be translated into measures of cost-effectiveness. This narrowing of the measure of student success was not welcomed uniformly by participants, some of whom reported concern that measuring costs would trump more nuanced measuring of student success. This pilot effort also found that the average cost for the programs studied ranged widely, as would be expected for a diverse set of programs and institutions, from as little as $60 per student to $1,600 per student—in all cases, just a fraction of average spending per student at these institutions. Because none of the participating institutions collected data on spending in other areas, however, the key question of comparative cost-effectiveness could not be answered.

Work on Learning Productivity

A final and quite promising area of work has been in the area of what Bruce Johnstone calls “learning productivity”—or ways to increase learning with either less time or less costly inputs. Johnstone has argued that the cost pressures facing higher education require a fresh approach to improving learning, by focusing less on cost cutting—something he believed (in 1993) had run its course—to improving educational throughput at reduced time or cost per student. The examples of learning productivity Johnstone and others have called for include

- Improving retention and degree attainment by reducing “excess” credits to the degree through better counseling and more prescribed curricula;
- Increasing opportunities to accumulate credits through credit by examination, early-college high schools, year-round operations, distance-based learning, and study abroad;
- Reducing time to the degree, thereby reducing student costs for tuition and fees; and
- Reducing the need for remedial education, leading to increased course work required before students can begin to accumulate credit for college-level work.

A good example of modeling cost-effectiveness and learning gains that might be possible through one form of “learning productivity” comes from Carol Twigg (1999) and her colleagues at the National Center for Academic Transformation (NCAT), whose work on course redesign began with research to test whether technologically delivered course work could be a cost-effective substitute for some of the large enrollment courses common in the first two years at most institutions. Learning and costs were assessed for courses delivered through a traditional lecture/discussion session format and were compared to those of courses delivered through distance-supplemented learning. The primary cost difference between the two forms of delivery came from less time spent in course and materials preparation and from labor savings by substituting low-cost “coaches” for faculty and teaching assistants. The researchers found superior results at reduced costs for the technology-enhanced courses. Twigg’s research is one of a very few examples of work that incorporates cost assessment into the assessment of learning goals and outcomes. She and others who have worked with the NCAT model for course redesign report that the requirement to look at costs is one of the most difficult—and ultimately, one of the most rewarding—aspects of the assessment process. Faculty in particular are reported to experience great frustration with the activity-based costing models that force the assignment of costs to activities that require them to distinguish between scholarship, teaching, research and service in a way that...
they resist, since they often see them as part of a seamless whole. Still, they reportedly find that the incorporation of costs into other assessments elevate the clarity and usefulness of the ultimate results.

The revenue meltdown of 2008 and 2009 has meant that “learning productivity” efforts are expanding rapidly, through the efforts of several state systems and other college leaders. In the University of Maryland system, a comprehensive initiative to tackle inefficiency and to increase effectiveness included limitations on reimbursements for credits earned above 120 units required for the degree (with exceptions for higher credit requirements from specialized accreditation) and a requirement that all students earn at least one semester’s worth of credits through some form of off-campus instruction: credit by examination, study abroad, or distance-based courses. Another example can be found in the University of Wisconsin system. They initiated a system-level effort to reduce “excess credit” accumulation, through early intrusive advising and greater attention to course scheduling and sequencing. After just two years, they reported an average reduction of credits and time-to-degree of about a semester per student.

One challenge to the efforts to promote concepts of learning productivity relates to the metrics of cost measurement and the absence of a standard methodology for calculating degree production costs or for measuring savings from increases in learning productivity. To address this challenge, the Delta Cost Project commissioned a University of Florida researcher, Nate Johnson, to recommend a methodology for calculating costs per degree that could be used to set baselines for measuring productivity (Johnson, 2009). Using unit cost data from the public database, Johnson looked at average direct instructional costs to produce a baccalaureate degree for students who both started and completed their degrees somewhere in the University of Florida system. He produced three approaches to do this: the “catalogue” cost, the “transcript” cost, and the fully attributed cost—the “catalogue” cost being the bare minimum of courses required for a degree; the “transcript” cost including the actual cost for credits (and any “excess” credits beyond the minimum required for the degree) taken by students who graduate from the institution within six years; and the full cost attribution including the costs of credits accumulated by both graduates and students who did not complete any degree within eight years of enrollment. Using these three approaches, Johnson found a good deal of variation among average cost by discipline—some disciplines (for instance the hard sciences and engineering) having higher average unit costs per course taken and others (such as communications) having higher average credits accumulated beyond the minimum required, as they seemed to be popular “second-choice” majors for students who began in business or engineering but switched majors after one or two years. On average, for students in the Florida system, he found the following production cost for the BA degree:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average catalogue cost across all disciplines for 120 credit units</td>
<td>$26,485</td>
</tr>
<tr>
<td>Transcript cost of credits actually taken by graduating students, averaged across all disciplines</td>
<td>$33,672</td>
</tr>
<tr>
<td>Full cost attribution, including credits taken by nongraduates</td>
<td>$40,645</td>
</tr>
</tbody>
</table>
Using this metric, “excess” credits add an average of 27% to the cost to produce a BA degree, and attrition another 21%. The relatively low cost of attrition—21%—was a somewhat surprising result to some, since the Florida public universities average less than a 60% cohort graduation rate. The difference however is explained because the majority of attrition occurs in the first year of college, when average unit costs per student are lowest. While no one would argue that the catalogue cost of degree production should be the goal—e.g., to reduce excess credits to 0 or to eliminate all student attrition—this methodology nonetheless could be the basis for adding cost analysis to institutional efforts to increase retention and improve degree production.

Reconnecting the Threads

Although more research is sorely needed, threads of what might be called an emerging consensus can be pulled from the research by generalizing from what is known and what might reasonably be surmised in the different works and by tracing the connections they have found between resources and different measures of learning and degree attainment. Restatements of the key findings follow.

- **Intentionality matters as much as or more than money alone.** Leadership matters, and institutions that have leaders that put resources behind instruction and student services show greater rates of persistence and graduation per dollar spent. The natural order in higher education is to let revenue availability determine spending priorities, rather than the other way around. But not all money is green. Much of the new money coming into higher education is targeted for spending on research or auxiliary enterprises and can’t be spent on the core functions of instruction and student services. If the national priority is to increase academic attainment, more can and should be done to focus institutional and policy leadership on student learning and degree attainment as the first priority for resource use—rather than leaving these issues at the bottom of the academic pecking order.

- **Focusing resources on instruction and student services helps to increase learning, retention, and degree attainment.** Investments in faculty resources make a difference in student learning; student services investments are especially important for increasing retention among institutions serving large proportions of at-risk students. In a time of cost reductions and rollbacks in support to institutions, the pattern among public institutions across the country has been to disproportionately reduce funding in instruction and student services. To reverse this trend, deliberate efforts must be made to protect funding for instruction and student services. By promoting more transparent assessments of how institutions spend money, state policy makers can help with this agenda, but the primary locale for these efforts is the institutions themselves.

- **Student financial aid programs need to be restructured to support the goal of student degree attainment as well as access.** Student aid makes the biggest difference in low-income access but less of a difference in success. Grant aid allowing students to attend college full time and increasing funding for on-campus work programs can help improve retention and graduation.

- **Excess units and student attrition cost money and do not help students get to the finish line.** Curriculum realignment, aggressive academic counseling, and attention to course scheduling can all help...
increase student success at reduced cost, both to the student and to the institution. Redesigning curriculum to ensure coherence and to focus on learning results can be cost-effective if done with an eye on spending as well as on student success and if accompanied by attention to student and academic support services aligned with the goal of increased learning success.

Concluding Thoughts

For a topic arguably so important, the existing body of work is embarrassingly thin. Using what we know and what we need to know as a point of departure, three areas emerge as priorities for future work.

1) Much more systematic work should be done on the use of faculty and student service resources and different measures of learning outcomes, including progress to degree for at-risk learners as well as robust learning results. This will require some massaging of data to create a good comparative sample of both staff inputs and learning outputs that can be compared over time and between different types of institutions. This work will not be inexpensive, but its cost could be reduced by pulling together data from existing state systems (in Florida, Illinois, New York, and Ohio, for example) that have course files and student unit record data.

2) Institutions and policy makers should promote greater transparency in cost reporting methods that focus on the ways institutions spend money. Without excessive detail, cost accounting can show broad patterns in where money comes from, where it goes, and what it buys. The Delta Cost Project has demonstrated that this can be done with existing data reporting through the federal IPEDS system. Institutions as well as states are, of course, free to supplement this aggregate data with more granular assessments.

3) Analysis of costs should be systematically embedded in the ongoing evaluation of students, whether of their learning outcomes or of their engagement behaviors. Adding cost analysis to ongoing assessments of student success will sharpen the focus and improve the usefulness of assessments. Student learning assessments have become too focused on compliance and do not yield results that are particularly helpful in making decisions about resources. Far too much cost analysis activity produces accounting information that has nothing to do with the use of the institution’s resources. The institution’s ongoing assessments, such as the institutional self-assessment within accreditation review as well as regular program reviews, could easily accommodate the addition of cost analysis. Activity-based cost calculators, such as those used by Delta, Noel-Levitz, and Twigg, are readily available and not that difficult to apply. Investments in training in assessment and in adding cost analysis to other dimensions of work would be required, however, since the language of cost analysis and metrics can be challenging to fathom. The addition of cost analysis will help demystify how institutions use resources and equip a new generation of leaders to think productively about how money gets spent. This is a far cry from enlightenment, to be sure, but lifting some of the ground fog is a good place to start.
References


Key Strategies for Making New Institutional Sense: Ingredients to Higher Education Transformation

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Transformational change forces institutions to adopt new conceptual frameworks, beliefs and meanings. This study investigates the strategies used to bring about institutional change that likely leads to new organizational sense-making. Through a qualitative investigation at six US colleges and universities, it identified key strategies that led to the adoption of new mental models, including ongoing conversations, processes to develop a set of concrete concepts, the use of cross-departmental working groups, public presentations, faculty and staff development opportunities, and the involvement of outsiders.


**Keywords:** institutional change; academic management; leadership; social cognition; sense-making

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**Introduction**

Changing state support, growth in technology, public scrutiny, changing demographics and massification, competing values, and the rapid rate of social change in the world both within and beyond national borders make change an imperative for much of higher education (see, for example, Duderstadt, 2000; Peterson and Dill, 1997).\textsuperscript{1} Some observers say these challenges suggest that institutions of higher learning can no longer afford to operate in familiar ways and conduct business as usual (Guskin, 1996; Levine, 1997) and institutions may well likely have to undertake significant change, or transformation (Clark, 1995; Dill and Sporn, 1995). Transformational change is a type of change unfamiliar to most institutions (Duderstadt, 2000). It alters organizational structures, affects organizational assumptions and ideologies, and is a collective, institution-wide undertaking (Johnson, 1987), although some link it to improved institutional effectiveness (Astin *et al.*, 2002). However,
transformation is not revolutionary change, and most likely will occur through incremental processes over significant time (Eckel et al., 2001). A characteristic of lasting transformational change is the alternation of institutional culture and ways of thinking (Gioia et al., 1996). As Schein (1992) notes, 'Behavior change can be coerced, but it will not last once the coercive force is lifted unless cognitive redefinition has preceded or accompanied it.' (p 302).

This study explores the institution-level strategies that university leaders can use to create new mental models important to transformational change. Having people collectively think differently about important institutional activities, reinterpret central goals, forge new identities, and develop new meanings and beliefs is the process of organizational sense-making (Bartunek, 1984; March, 1994; Smircich, 1983; Weick, 1995). Transformation creates opportunities and problems that call for collective interpretation: What are we about? Who are we? What is important? What are our priorities?

The link between major organizational change and sense-making has been established (Bartunek, 1984; Eckel, 1998; Gioia and Chittipeddi, 1991; Gioia et al., 1996; Johnson, 1987), as well as how it occurs among senior university administrators (Gioia and Thomas, 1996). However, we do not know if particular change strategies facilitate sense-making across the institution, or how leaders might structure sense-making into their change processes. The questions guiding this study are: In periods of intentional transformation, what processes and activities (also termed strategies) facilitate collective sense-making within colleges and universities? What can leaders do to stimulate sense-making as part of the change process?

This paper is based upon secondary analysis of a project on institutional transformation in US higher education, where earlier findings suggest that sense-making played a central role in effecting transformation (Eckel and Kezar, 2003).

Theoretical Framework

The concept of organizational sense-making comes from an interpretive conceptual understanding of organizational behavior, where organizations are viewed as ambiguous, and actors create meanings and construct realities that shape actions. Organizations are not static entities to be understood; rather people spend their time gathering information, interpreting meaning, negotiating importance, and evoking symbols to create organizational realities (Boiman and Deal, 1991; Birnbaum, 1988; March, 1994). Through ongoing meaning making, leaders address questions such as what is happening in the world and why, what is truth, what is important to the organization, and what behavior is proper (March, 1994; Weick, 1995). From this understanding,
decisions become important because they create opportunities to focus attention and establish meaning, not because they maximize results (March, 1994). What people do helps them create interpretations and meaning. Thus, in times of change, strategies and activities help new meanings become ascribed to changing organizational phenomena (Gioia et al., 1996). This study concentrates on those activities.

Sense-making is difficult to capture directly (Weick, 1995). However, it is possible to identify activities in the change process where sense-making is likely to occur. Weick (1995) offers a set of seven sense-making properties that can be used as a template to identify sense-making activity. Weick’s seven properties include:

**Grounded in identity construction**

People ask themselves, ‘what implications do these events have for who I will be?’ (Weick, 1995, 23–24). Individuals explore their identities in relation to the organization. Identity construction occurs at the individual and the institutional level, where people redefine who they are collectively.

**Retrospective**

Sense-making is retrospective because people can only make sense from what has already occurred. ‘Actions are known only when they have been completed, which means we are always a little behind or our actions are always a bit ahead of us.’ (Weick, 1995, 26). For example, categorizing an emerging issue as either a threat or an opportunity is dependent upon sense made from past experiences.

**Enactive of sensible external environments (bracketing)**

People bracket and segment a socially constructed environment in ways that make sense to them. Sense-making is influenced by the noticing, manipulation, interpretation, and framing of the changing and uncertain environment.

**Social**

Sense-making is about talk, discourse, and conversation, and it is based upon collective action. It is dependent upon the interactions of people to create meaning by working together, obtaining information from one another, acting, and reacting.

**Ongoing**

Sense-making is continuous as people are constantly engaged in sense-making. However, it is dependent on the ways in which people ‘chop moments out of
the continuous flows and extract cues from those moments.' (Weick, 1995, 43). The ongoing flows of everyday life are interrupted, causing people to become highly aware of both those flows and their disruptions.

**Focused on extracted cues**

Sense-making is dependent on the cues people extract from the flow of activities and events, and their embellishments of those extractions. ‘Extracted cues are the simple, familiar structures that are seeds from which people develop a larger sense of what may be occurring.’ (Weick, 1995, 50). The cues provide points of reference that further shape the sense-making process. Context affects what is noticed and how it is interpreted.

**Driven by plausibility rather than accuracy**

‘Accuracy is nice but not necessary’ in sense-making (Weick, 1995, 56). However, the sense made must seem plausible and reasonable to those in the organization. Sense-making is not about being right; rather it is about acceptability and credibility.

Weick (1995) views sense-making as an important element of ongoing organizational life. However, this study specifically focuses on a specific organizational activity, transformational change, and not all of his properties may be equally applicable; some might occur somewhat differently. (However, the authors acknowledge that sense-making is constantly happening and change is ongoing, much of which is unintentional.) Here, the focus is on understanding how intentional, large-scale change is related to sense-making. A potential key difference is that a particular transformational change agenda is bounded in time. For instance, the property of being ongoing might have limits because each institution’s change efforts have a recognizable (and socially constructed) launching period. Within the change process, Weick’s concept of ongoing might be better thought of as threads occurring through numerous activities.

We use Weick’s seven properties to identify the strategies that shape the creation and adoption of new sense related to the process of institutional transformation.

**Research Design and Criteria**

This study is based on six US institutions that undertook transformational change efforts around teaching and learning. These institutions participated in the ACE Project on Leadership and Institutional Transformation, a five-and-a-half-year initiative on institutional transformation funded by the WK
Kellogg Foundation. The intent of the project was to help institutions effect large-scale change rather than engage in disinterested research.

Twenty-six institutions were selected purposefully through a national competition from a pool of 110 applicants (Yin, 1994). Institutions were selected with different missions (community colleges, liberal arts colleges, and universities) and that had a good chance of effecting large-scale change. For the analysis in this paper, a sub-set of six institutions was identified from the 23 institutions that elected to continue in the final 2 years of the project. These institutions (1) made the most progress toward their intended transformation objectives, (2) were working on similar agendas centered on teaching and learning and represented different types of institution, and (3) provided well-detailed descriptions of their change processes to discern activities that facilitated sense-making, providing the thickest descriptions of complicated processes from which to draw conclusions. The six institutions represented a range of organizational complexity from a small liberal arts college with 72 faculty to a four-campus community college serving over 50,000 students.

Over the life of the project, each institution and the project staff interacted 24 times. A project consultant — who was a former college president or experienced higher education management consultant — or an ACE staff member visited each campus twice during the first 3 years. During the last 2 years, a two-person team of project consultants and ACE staff who had not been affiliated with that particular institution during the first phase visited each campus once. For the first 3 years, ACE held two project meetings a year for campus leadership teams of faculty and administrators, and obtained two written self-evaluations each year. During the final 2 years, ACE convened institutional project teams annually and requested a written report prior to each meeting.

For each institution, the researchers created a case portfolio of all sources of data. Within the portfolio were the institution's application for the project, eight written reports from the institution, eight campus visit reports by project staff, notes from phone calls, summaries of project meeting discussions, and other documents produced by the institution relating to the transformation effort.

Data analysis was conducted through a two-stage process that focused on organizational level (not individual) sense-making. First, we used Weick's seven properties of sense-making as the template to identify opportunities for sense-making. We identified change strategies as sense-making opportunities if they had a majority of the seven properties. Because of the nature of the properties and because of the type of data sources, identifying all seven properties was difficult. For example, we might only determine the presence of retrospection if we had meeting agendas or summaries that illustrated a discussion of the past. Second, we focused on discrete activities related to effecting change, and gave special attention to the discussion of identities and
cues relating to Weick’s sense-making questions of ‘what is ‘out there,’ what is ‘in here,’ and who must we be in order to deal with those questions?’ (p 70). We additionally focused on elements that reflected social interactions, a changing environment, and discussions of plausibility and coherence with institutional purposes, expectations and values.

The second process, to identify likely strategies for sense-making, adopted a three-step qualitative approach: (1) categorical analysis; (2) memoing; and (3) narrative analysis (Miles and Huberman, 1994). Categorical analysis was used to identify strategies and outcomes of sense-making. We created a set of emergent labels to catalog these activities. Second, memoing, a process of writing up ideas of the pattern coded data, helped to identify interrelationships among identified elements (Miles and Huberman, 1994). Lastly, the themes were illuminated through narrative analysis.

To ensure rigor, we (1) used multiple sources of evidence to create converging lines of inquiry, (2) constructed a database of information for each case, and (3) developed a logical chain of evidence that linked the analysis to specific instances in the case database and to the research questions (Yin, 1994). To ensure trustworthiness, we independently reviewed the data and drew conclusions, engaged in peer debriefing, and used a participant check (Lincoln and Guba, 1985). This research is not without limitations. Institutions were not selected in the ACE project for their representativeness, but rather with the likelihood of making progress. The project, because it sought to help campuses make progress toward goals, consisted of consultations and activities intended to foster transformational change that may have effected sense-making, particularly national project meetings, campus site visits, and report writing that all asked people to reflect on the change process.

Findings

The findings describe the common change strategies that facilitated sense-making across the studied six institutions. For each of the six strategies below — widespread conversations, cross-departmental academic teams, staff training, outsiders and their ideas, concrete ideas and guiding documents, and public presentations — select examples from the studied institutions illustrate how institutions accomplished these tasks. Their specific approaches varied because of their size, complexity, and institutional cultures (Eckel and Kezar, 2002). In addition, each change strategy is linked to Weick’s various sense-making properties. Tables 1 and 2 illustrate as examples the change activities at a community college and a research university related to sense-making. For a more detailed explanation of the change processes at these institutions, please see the larger study presented in Taking the Reins (Eckel and Kezar, 2003).

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Table 1  Blooming Community College activities by sense-making properties

<table>
<thead>
<tr>
<th></th>
<th>Identity</th>
<th>Retrospect</th>
<th>Environ</th>
<th>Social</th>
<th>On-Going</th>
<th>Cues</th>
<th>Plausible</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996 campus roundtable</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Transformation workshop</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2nd roundtable action teams</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Staff welcome back retreat</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff professional development</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference guidebook</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff presentations at conferences and outsider speakers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Table 2  Central State University activities by sense-making properties

<table>
<thead>
<tr>
<th></th>
<th>Identity</th>
<th>Retrospect</th>
<th>Environ</th>
<th>Social</th>
<th>On-going</th>
<th>Cues</th>
<th>Plausible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year-long academic staff seminar</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Campus-wide symposium</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2nd seminar</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revamped center for academic excellence</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Academic working groups</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Guiding document</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participate in national projects</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<td></td>
</tr>
</tbody>
</table>
Numerous, continuous and widespread conversations

At all six institutions leaders held ongoing and widespread campus conversations that helped people recast key concepts to fit new realities and to explore ways in which they fit in the emerging future. Through conversations held at campus retreats, seminars, roundtables, and symposia, academic staff and administrators developed a new common language and a consensus on ideas; they helped to reframe key core concepts. For example, at one community college, administrators and academic staff collectively addressed: what would it mean for them to become a learning-centered institution? At another university, the question pursued was what does it mean for us to be an urban public university?

These conversations were multiple and ongoing. The community college developed a series of structured roundtable conversations, held three times over a 2-year period, which involved anywhere from 150 to 300 people. Another institution developed a seminar to bring 30 academic staff and senior administrators together to over the courses of the academic year to intellectually explore the history of higher education and put the institution’s current challenges in an intellectual and historic context. After the first seminar was completed, the participants identified five key themes and created working groups to intellectually explore each, widening the circle of participation. Many of the institutions developed a set of retreats and working groups that fostered communication and exploration.

Leaders at each of the three institutions created multiple opportunities for participants to wrestle collectively with ideas and new ways of thinking. The conversations occurred serially, with each conversation built upon its predecessor. A one-time conversation was insufficient to work through issues as difficult and complex as creating new cognitive frameworks. The conversations were inclusive and were scheduled to ensure maximum participation. For example, one set of the community college’s roundtables occurred prior to the beginning of the academic year to ensure widespread faculty involvement.

The ongoing conversations reflected Weick’s sense-making properties in the following ways. The conversations allowed people to construct new identities collaboratively and openly (i.e., they were social). In many cases, they were retrospective as participants discussed current challenges and future directions in comparison to past beliefs and activities. They frequently started from commentaries on the changing environment. They focused on particular elements of the change process (bracketing) and, oftentimes, were about what is plausible for the institution given its history, norms, and social functions.

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Cross-departmental teams

Institutions found ways to bring together people (particularly academic staff) who typically did not work together. These working groups brought together different combinations of academic staff and administrators (and sometimes students) who had different perspectives and different assumptions. Many institutions conduct most of their work through departmental ‘silos’ with little cross-unit interaction. The cross-fertilization of ideas and the challenges associated with bringing together people with diverse perspectives and beliefs helped to encourage the exchange of ideas and loosened tightly held assumptions that helped facilitate sense-making.

For example, a liberal arts college developed faculty working groups to visit a set of peer institutions to study their approaches to general education. Later the president developed eight task forces, each responsible for implementing a portion of the new academic plan. At the conclusion of the task forces, institutional leaders estimated that 50–60% of the academic staff had participated. A community college developed a set of academic-led working groups. One group focused on core processes, another on core competencies, a third on institutional vision and character, and a final one on short-term accomplishments. In another example, one of the research universities created cross-college academic teams to work on issues such as learning outcomes and assessment, writing and communication, numerical literacy, and other goals of their change agenda.

Their links to the Weick sense-making properties were as follows. These working groups were social, in that they brought together people to work on a set of concrete tasks. They touched upon identity and plausibility as ideas were tested to determine their fit with the institution and its goals. They focused on smaller cues associated with the change agenda that provided the ‘seeds’ of sense-making. They were ongoing in that teams met many times to continue previous conversations. It is difficult to tell the extent to which cross-departmental groups discussed the environment and if retrospective.

Staff training

Institutions developed comprehensive faculty development programs to support their change agendas. Many institutions created orientation programs for new academics, helping to shape their socialization into the institution. Other institutions developed centers for teaching excellence or for faculty development that sponsored an ongoing set of workshops and seminars aimed toward academic staff. Some institutions identified off-campus development opportunities and sent teams of faculty to participate. One community college purchased a nearby building and turned it into a full-time training center that
offered a variety of programs directed toward academic staff, administrators, and support staff. This institution also developed summer workshops for faculty who teach under-prepared students, and an informal discussion group for faculty at different campuses who all taught common courses, such as mathematics and writing. One research university provided deans with substantial money for each individual college to develop its own staff development program.

Many institutions ran ongoing brown-bag lunch discussions that focused on topics such as student assessment, portfolio development, etc.

The links to Weick’s sense-making properties are as follows. Development opportunities brought together people in a social way to learn new skills and gain new knowledge related to the unfolding changes. Many of these activities were ongoing, including brown-bag discussions, seminars, and faculty discussion groups. They focused on adapting ideas from elsewhere (portfolio assessment) and making them plausible to fit local contexts and challenges.

Outsiders and their ideas

The change processes at these six institutions benefited from the ideas, comments, suggestions, and challenges from interested outsiders who challenged key institutional beliefs and assumptions. In many instances, these outsiders had latitude to ask challenging questions difficult for campus leaders to raise, particularly when they were invited speakers or paid consultants. The institutions also benefited by sending staff and senior administrators to off-campus activities. Institutions participated in a variety of national and regional projects with other colleges and universities. They also sent groups of academics and administrators to regional and national conferences. Leaders additionally frequently distributed key readings and developed ways in which to discuss those readings at retreats, during regularly scheduled meetings, or through reading groups specifically organized as professional seminars. However, leaders did not simply distribute readings; they developed mechanisms to actively engage the campus in a discussion of the ideas from people beyond the campus borders.

For example, at one research university, the Center for Teaching Excellence sponsored a symposium that brought together 200 academic staff and administrators and featured a set of national experts discussing key themes related to the institution’s transformation agenda. The afternoon consisted of faculty reacting to the ideas presented by the speakers and a set of small group conversations to explore the implications of the early topics for the institution. At a different research university, administrators sponsored a set of public lectures by nationally renowned experts. Each lecture was linked conceptually...
to the others and introduced different perspectives on related topics. A community college identified a set of common readings that it widely disseminated on its campuses. It then organized facilitated discussions to explore the article, argue with its thesis, and explore potential implications for the college. A liberal arts college, in addition to a highly publicized speaker series, sent teams of academics to numerous conferences and site visits. Each visiting team was given a concise set of questions to explore during its time away from campus. The institution, because of its small size and rural location, believed it needed to expose faculty to new ideas by sending them off-campus and giving them the responsibility of engaging colleagues upon return. This same institution was able to forge a partnership with a well-known professional development seminar. It sent any willing faculty and staff to a week-long seminar run by the group and held a 2-day workshop for the entire university staff.

The connections to Weick’s sense-making proprieties include the following. Outsiders and their ideas challenged current ways of knowing and perceiving, helping the institution to consider what is plausible and to reflect collectively (socially) upon past ways of operating and thinking (retrospective). They provided cues and brought perspectives on the changing environment. The influence of outsiders may not have been ongoing, except where institutions used readings as part of continuing faculty development opportunities.

**Concrete ideas and guiding documents**

Change leaders organized processes to develop a guiding document (or set of documents) or craft a set of concrete ideas that would shape the direction of the change agenda and connect it to important institutional values. Although the document(s) themselves were important, the process of creating, drafting, circulating, discussing, rewriting, presenting, and polishing the document may have been the larger contribution to making new sense. Writing down important ideas got people to talk about their assumptions and leaders engaged the campus continuously at faculty retreats, cabinet meetings, and campus forums.

A liberal arts college developed an open and inclusive process to create a campus compact, a document that would help the college ‘articulate its most basic values’ and set the institutional vision. After an initial retreat involving over 250 people, including academic staff, administrators, students, community members, and trustees, a working group developed numerous drafts, vetted them with different stakeholder groups, debated their suggestions, and then sought the endorsement of student and staff senates, the entire academic staff, and the board of trustees. At a different institution, academic staff created a
document that reflected a set of guiding education principles to shape the new general education curriculum. However, rather than create a traditional planning document, the faculty working group instead presented multiple and conflicting viewpoints about what a general education curriculum might be. They then sought feedback on the variety of options presented. They took the feedback and created narratives to reflect the ongoing debate over key curricular issues. Through this dialectic, institutional leaders were able to identify potential conflicts and points of departure and surface implicit assumptions that might create future stumbling blocks.

The process of creating documents and developing a set of guiding ideas involved many people (social). Documents were not drafted alone, but by groups of people. In the process of writing, debating, and rewriting, those involved re-examined key assumptions, and their roles in light of the issues being explored. The content typically brought into relief questions about their identities. These documents talked about what the institution was becoming, thus acknowledging past ways of operating (retrospective). The documents tended to be inward focused and not talk about the environment, except in prefatory comments.

Public presentations

Institutions created numerous opportunities for people involved in the change efforts to give public presentations about the institution and its change agenda. The practicality of putting together and delivering presentations may have helped unfreeze mental frames and begin to develop new models. First, organizing and creating a presentation demands that people think about their ideas and assumptions. Second, hearing their own presentations and speaking aloud creates another opportunity for an individual or group to catalyze thoughts. Finally, the presenters have an opportunity to hear and respond to questions from the audience.

All of these institutions were involved in at least one other national or regional project in addition to the ACE project, and a couple were involved in numerous projects on a range of related topics. Each project was intended to advance a different part of the institution’s transformation agenda and each provided a different avenue to speak publicly about the institution and its transformation efforts. As one administrator from a research university noted, ‘the national discussion regarding issues and problems in higher education sustains the change. Faculty exposure to and participation in this discussion increases their interest and understanding of our change process.’

The connections to Weick’s sense-making properties include the following. The process of putting together public comments was rarely a solo activity; instead it was social and collective. The public presentations tended to focus on
what the institution had become or had accomplished and, thus, was retrospective. It reinforced what was plausible within the institution’s culture and built upon ongoing work, ideas, and accomplishments. These presentations told audience members who the institution was and what it was becoming, and why. It placed the institution’s effort in an environmental context needed to explain why the institution was undertaking large-scale change. These presentations brought together discrete elements of the change process and placed them in a larger perspective.

A chronology of sense-making strategies

In addition to the specific change strategies that facilitated sense-making, the finding suggests that these activities are clustered chronologically, depending on the stage of the transformation agenda. One set occurred at the beginning and middle of their efforts — engaging in continuous, widespread conversations, developing working groups, benefiting from outsiders and their ideas, and sponsoring faculty and staff development opportunities. At later stages, the sense-making activities switched to preparing and giving public presentations and creating documents or concrete sets of ideas. This evolution does not suggest that institutions stopped their earlier sense-making activities; however the amount of time and attention spent on them did change.

Implications

The results from this study suggest a series of implications. First, effecting transformational change is as much about ideas and thinking as it is about action. Getting people to adopt new mental models is a cognitive and intellectual process, and implementing transformation is not simply dependent upon changing structures, policies, and reward systems. New pay systems alone do not induce new sense.

Institutional change leaders should intentionally design change strategies that facilitate new sense, leaving behind old ideas, assumptions, and mental models. Leaders at these institutions asked themselves questions early in the transformation process that initiated sense-making. Blooming Community College asked itself, “What does it mean for a community college to put learning first?” By intentionally developing sense-making activities in an institution’s change processes, institutions might effect change more quickly and more smoothly than institutions where sense-making strategies are accidental.

The findings suggest that transformation is an open-systems process, as outsiders play important roles in facilitating institutional change and in adopting new sense. Institutional leaders should not adopt an isolationist attitude if the outsiders are selected intentionally for their challenging and different views.
Peter D. Eckel and Adrianna Kezar
Key Strategies for Making New Institutional Sense

Additionally, higher education transformation, from a sense-making perspective, requires more leaders and participants, not fewer. No heroic leaders who independently will effect transformation need apply. Keeping the responsibility for leading change to a few high-level administrators does not create the widespread opportunities for participation and interaction needed for collective, institution-wide sense-making. Revealing a final product or a well-crafted plan produced by a few does little to encourage sense-making and does not allow for a large number of individuals to participate in making new meaning.

Finally, a few words about Weick’s (1995) sense-making framework, which was developed to explain ongoing organizational life, not a specific process. The results suggest that his elements do not fit evenly across the change strategies and that sense-making, as it relates to institutional transformation in higher education, is dependent more on some properties than on others. For example, the elements of identity and plausibility, its social nature, and the use of extracted cues were readily observable in most of the strategies. On the other hand, change strategies that fostered sense-making were not uniformly retrospective or connected to the environment. One might conduct future research on the variation in sense-making principles as they pertain to institutional transformation, investigating the ways in which sense-making properties vary, when they vary, and the extent to which that unevenness affects sense-making.

Notes

1 This study was conducted as part of the Kellogg Forum on Higher Education Transformation, sponsored by the WK Kellogg Foundation. An earlier version of this paper was presented at the 2001 Annual Meeting of the American Educational Research Association in Seattle WA. The authors thank Linda Johnsrud and anonymous reviewers for their helpful comments. An extended discussion of the project upon which this work is based appears in Eckel and Kezar (2003).
2 The names of the institutions are pseudonyms.

References


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The CSU Fullerton sessions will take place in the Titan Student Union (TSU) – Rooms: Ontiveros AB, Alvarado AB, Tuffree AB.
Please park in the State College Structure (SCPS) located off of State College Blvd and Student Union Drive. Once you turn into Student Union Drive, make a left at fork and right into the structure.
The Titan Student Union (TSU) is adjacent to the parking structure on the south side.