Assessment for Course and Program Improvement

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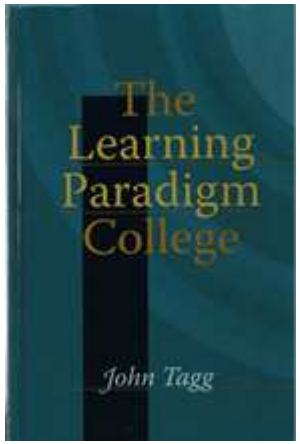
Physics Department Chairs Conference, June 6-8, 2014

WESTERN MICHIGAN UNIVERSITY

Panelists

- David Kuehn, Pittsburg State University
  - Assessment at course and program level
- Jesus Pando, DePaul University
  - Assessment that meets both the department and university interests
- Peter Saeta, Harvey Mudd College
  - Assessing the efficacy of a "sidecar" support course in parallel with 1st year Mechanics

Some Assessment-Related Pressures

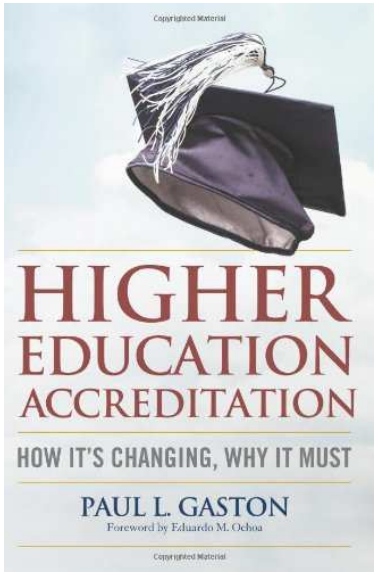


Shift in thinking about faculty role

- teacher-centered to student-centered

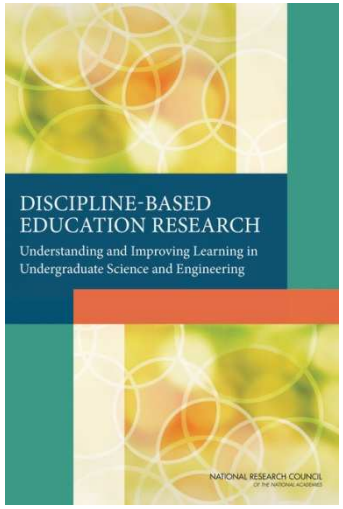
Changes in Regional Accreditation

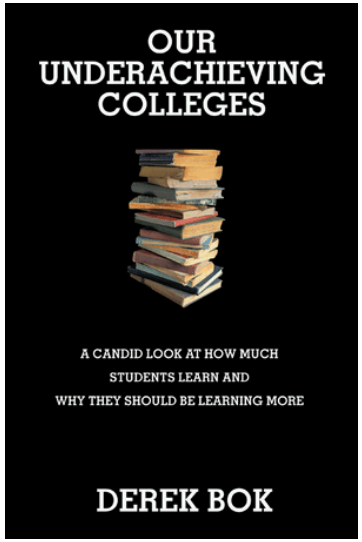
- Outcomes rather than inputs
- Continuous improvement rather than minimal standards



Education Research

- New measurement techniques

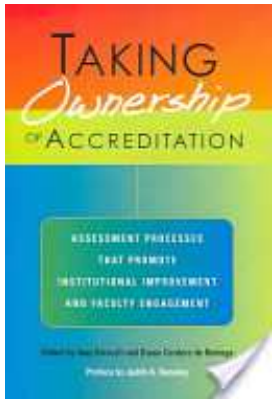




Concern from Public and Policy Makers

- Need to justify value of higher education

Is this what assessment looks like at your institution?



"The program review process is seen as a perfunctory exercise to be performed at specific predetermined intervals to meet the requirements of an external authority or institution. The process generates reams of paper, which while satisfying the needs of the external authority, have little or not impact on the day-to-day life of the academic unit. The process, like other aspects of accreditation, is often seen by faculty as busy work, and has very little to do with the units' academic goals or processes of continual renewal." (p. 73)

Redirect rather than fight

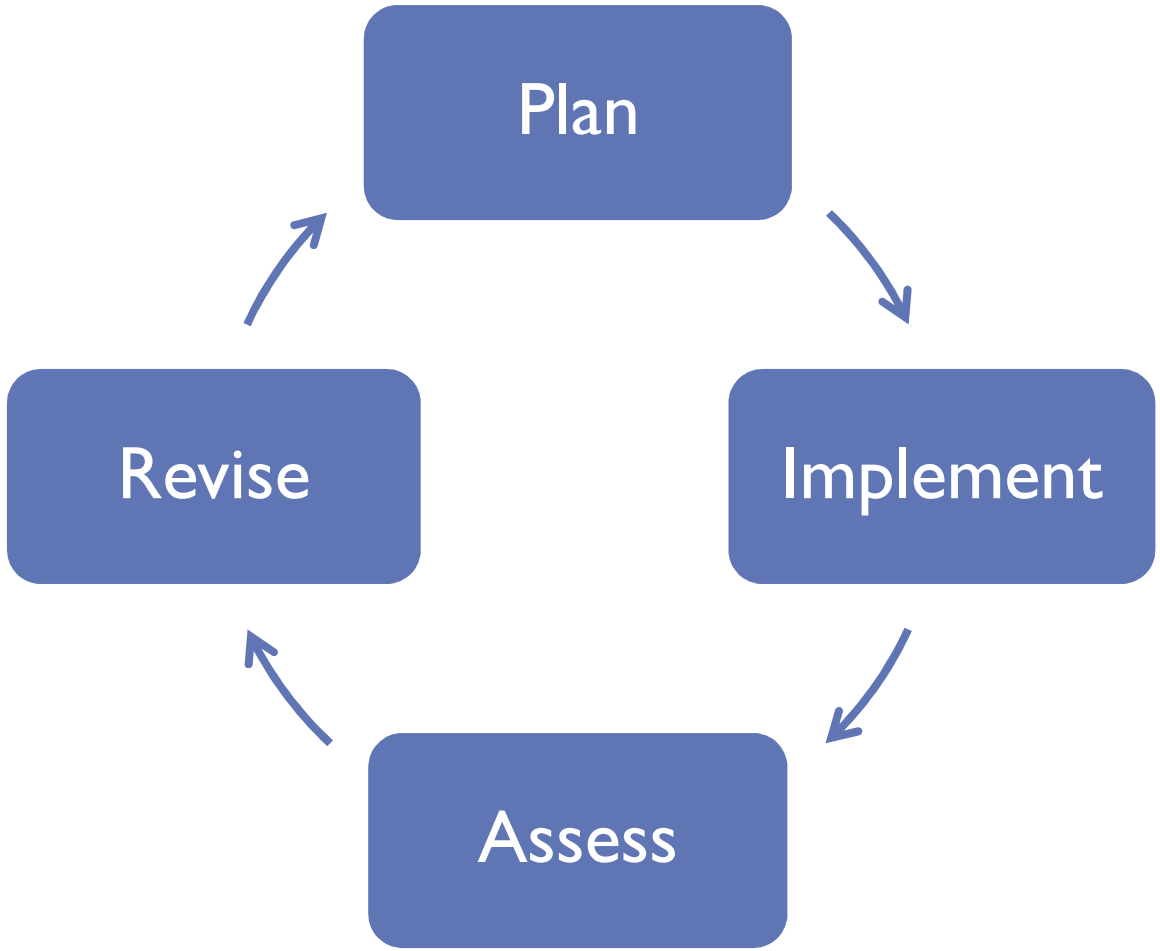
Aikido is performed by blending with the motion of the attacker and redirecting the force of the attack rather than opposing it head-on.

Assessment is a Simple Idea

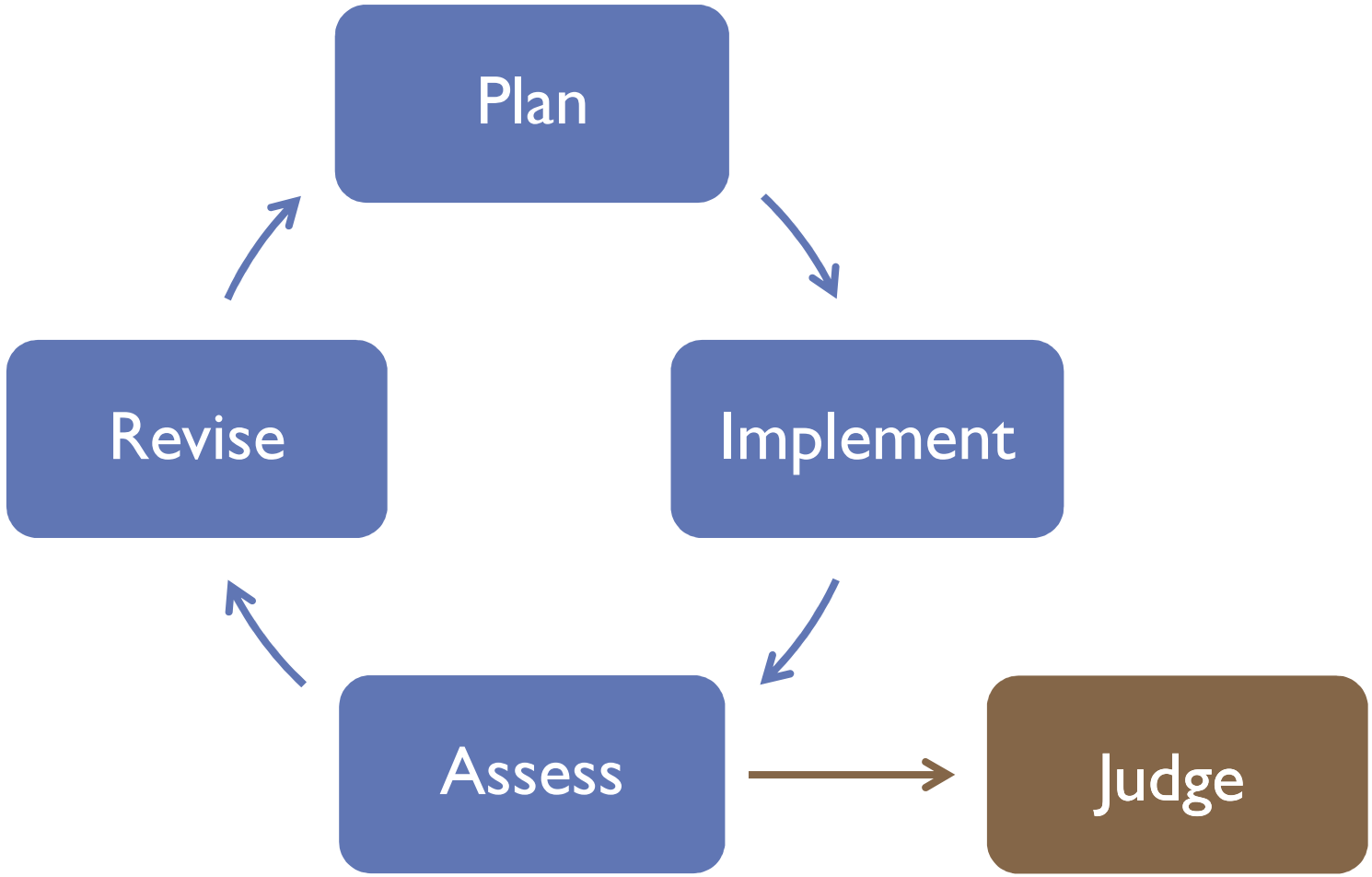
Assessment Questions

1. What are the major goals?
2. Have they been met?
3. How do we know (evidence)?

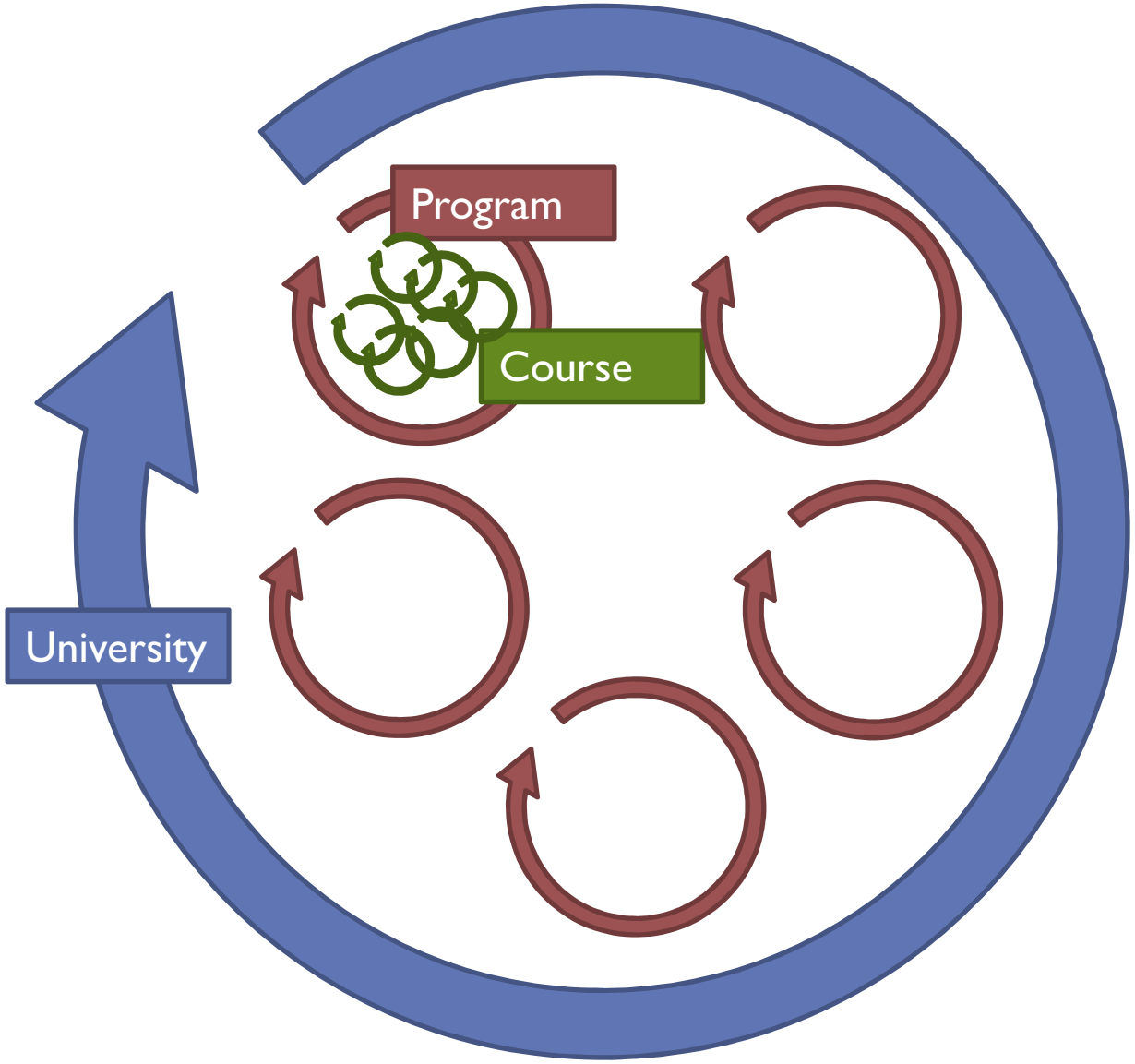
Assessment is part of the continuous improvement cycle



Assessment is also used to judge performance



Levels of Assessment



Purposes of Assessment and Relationships

	Improve	Judge
Course	Course Improvement (Instructor, Department)	Personnel Decisions: (Department, Institution)
Program	Program Improvement (Department)	Program Review: Accountability and Allocation of Resources (Department, Institution)

= Simplify/Summarize

Course Level

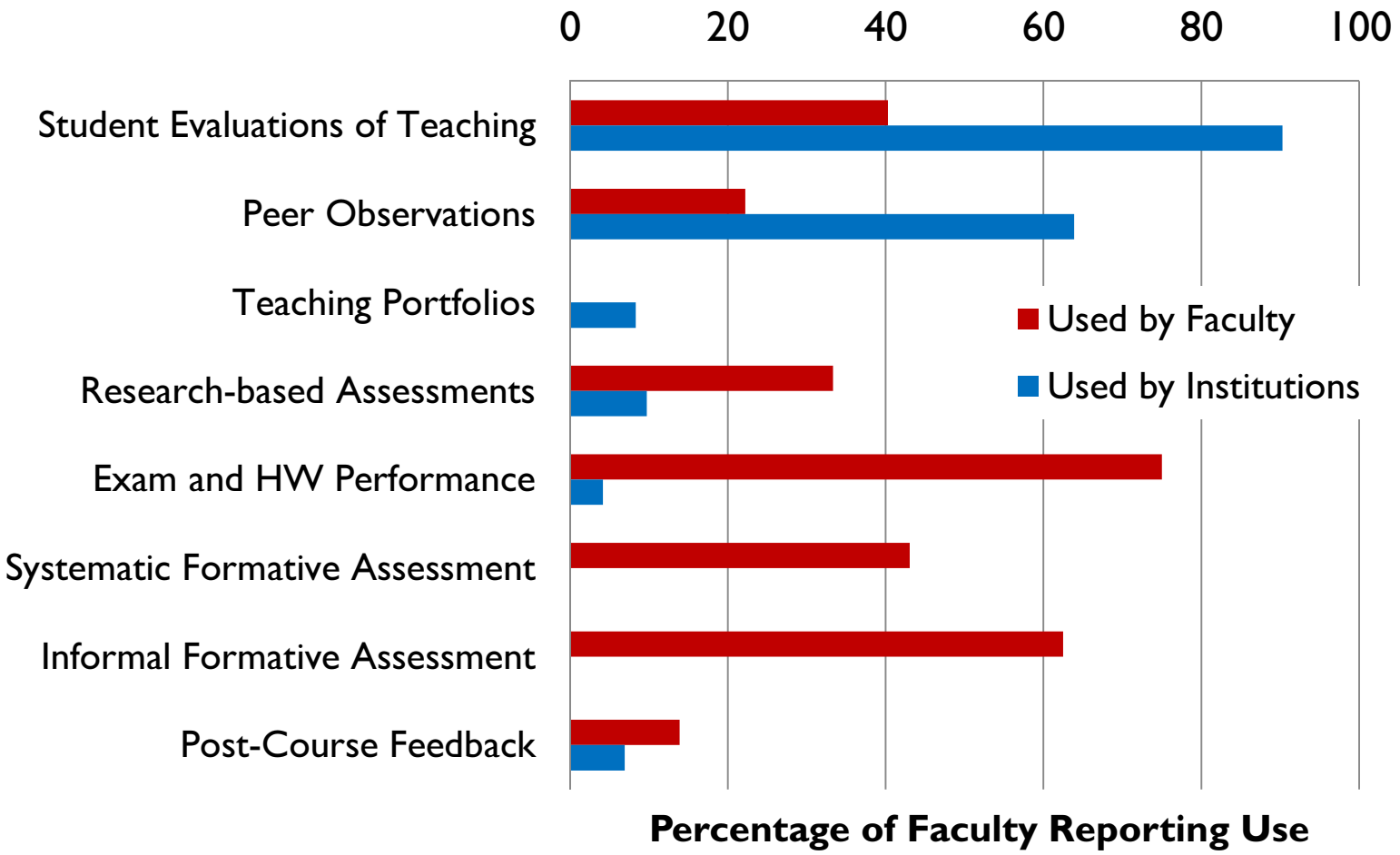
Data Source

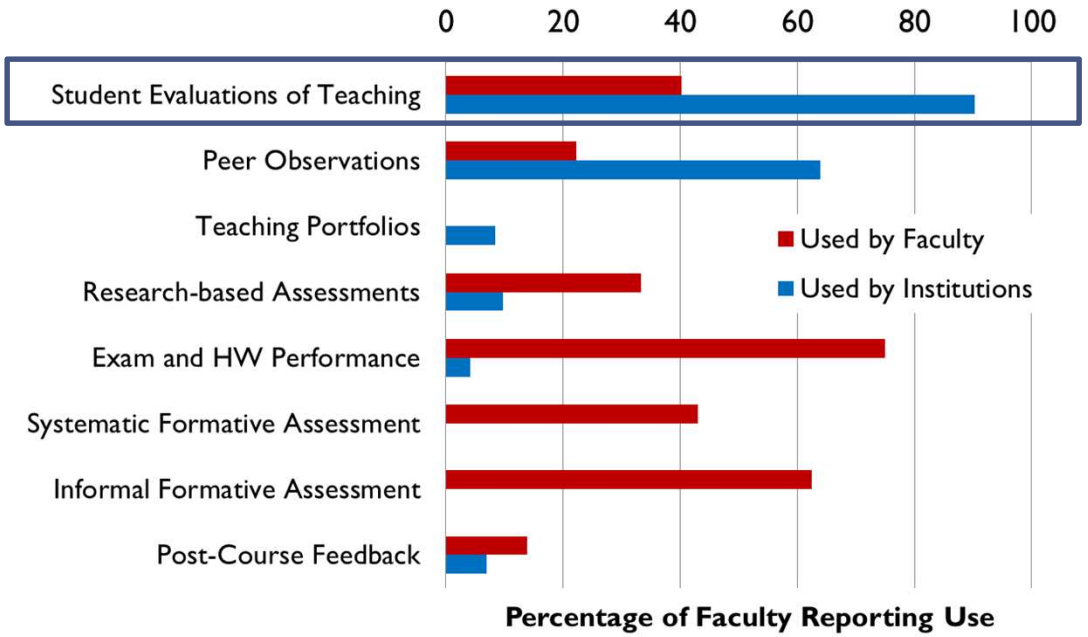
- N=72 physics faculty
- Semi-structured telephone interviews
- Assessment-related data from throughout the interview
- Specific questions about assessment
  - How do you know if your instruction is working?
  - What criteria does your institution use to evaluate teaching?

Henderson, C., Turpen, C., Dancy, M., & Chapman, T. (2014). Assessment of teaching effectiveness : Lack of alignment between instructors , institutions , and research recommendations. *Physical Review Special Topics - Physics Education Research*, *10*(1), 010106. doi:10.1103/PhysRevSTPER.10.010106

What Assessment Sources are Currently Used?

(Faculty perceptions inferred from interviews, N=72)



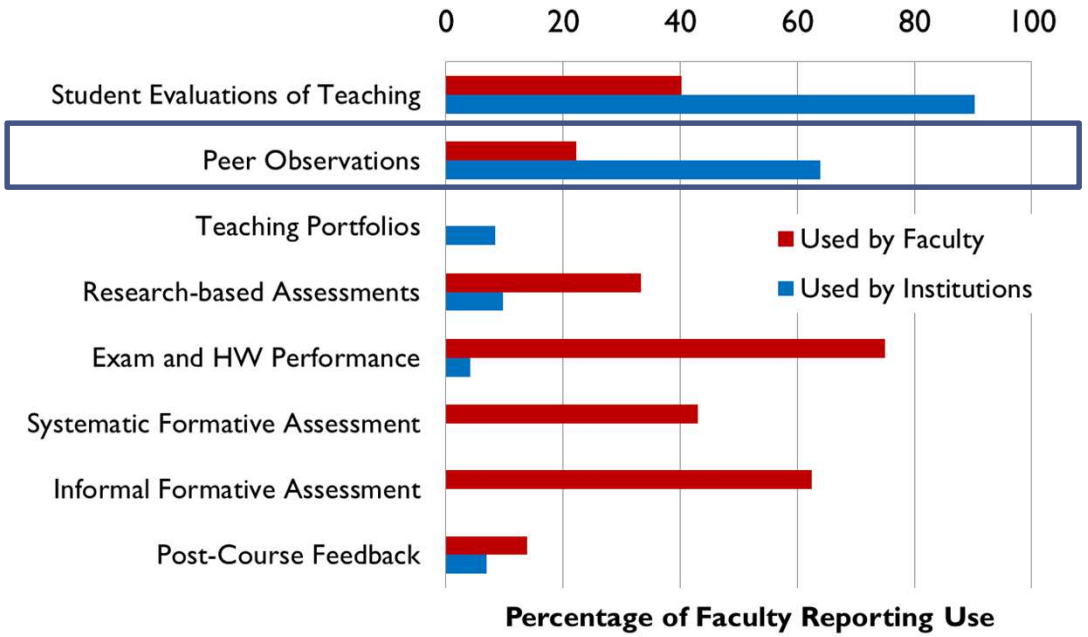


Institutions and departments typically base most or all of their assessment of teaching effectiveness on the numerical ratings from SETs, a measure that many faculty are skeptical of.

Nobody thinks this is a good idea.

SETs could be improved with existing knowledge, (e.g., salgsite.org).

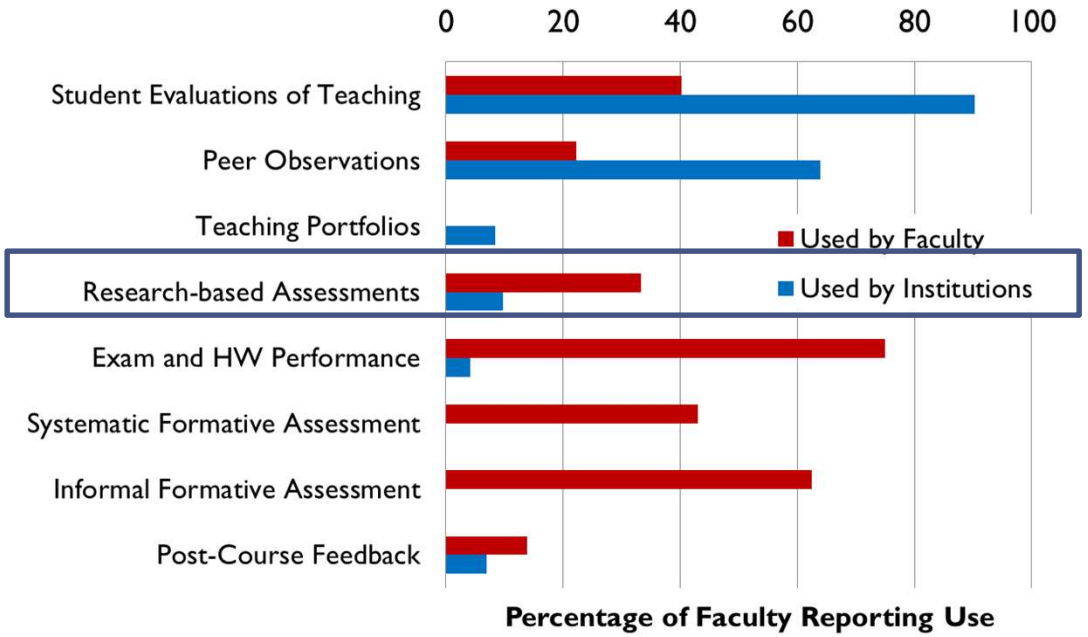
When peer observations are used, there are no predetermined criteria.



Seven guidelines for useful peer observations:

1) o
2) a ...not sufficient
3) p... t the course a... necessary to... ...er
4) th... ...should help to... ...a checklist or rating form)

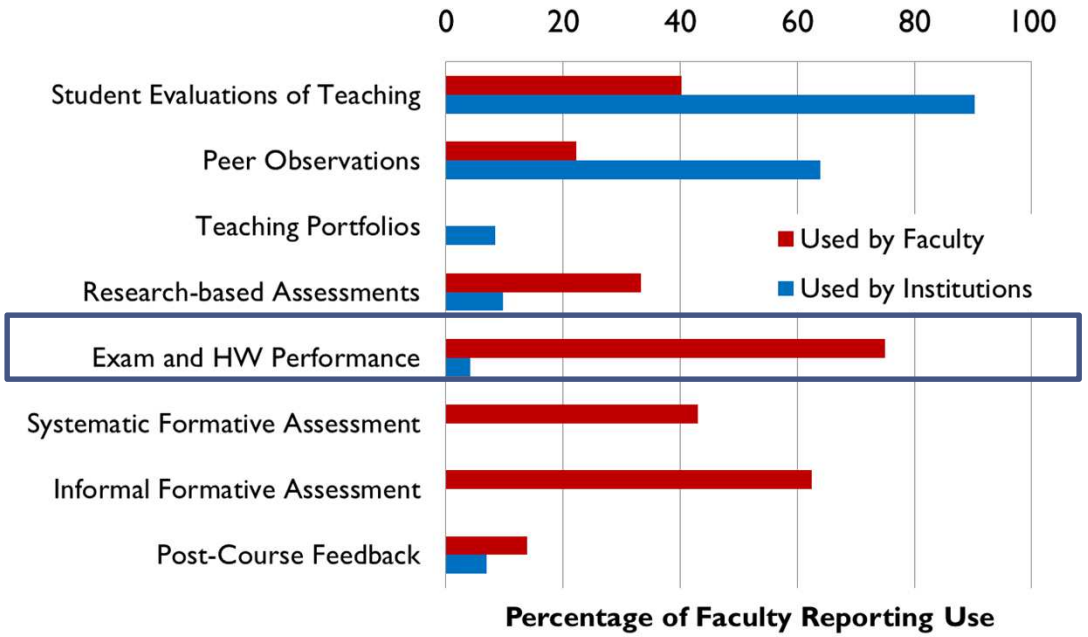
Would be useful for departments to agree on purpose and procedures for peer observations



Not common to use available nationally-normed research-based assessments (such as the FCI).

This is the easiest course-level evidence to summarize for higher levels.

PER User's Guide
Physics Education Research
Evidence-based resources for teaching physics



Faculty base much of their assessment of teaching effectiveness on student test performance. Institutions and departments rarely use this information.

These can be summarized for course judgment and build to program level.

Purposes of Assessment and Relationships

	Improve	Judge
Course	Course Improvement (Institution)	Personnel Decisions: (Department)
Program	Program Improvement (Department)	Program Review: Accountability and Allocation of Resources (Department, Institution)

Mainly Informal Measures

Limited Measures

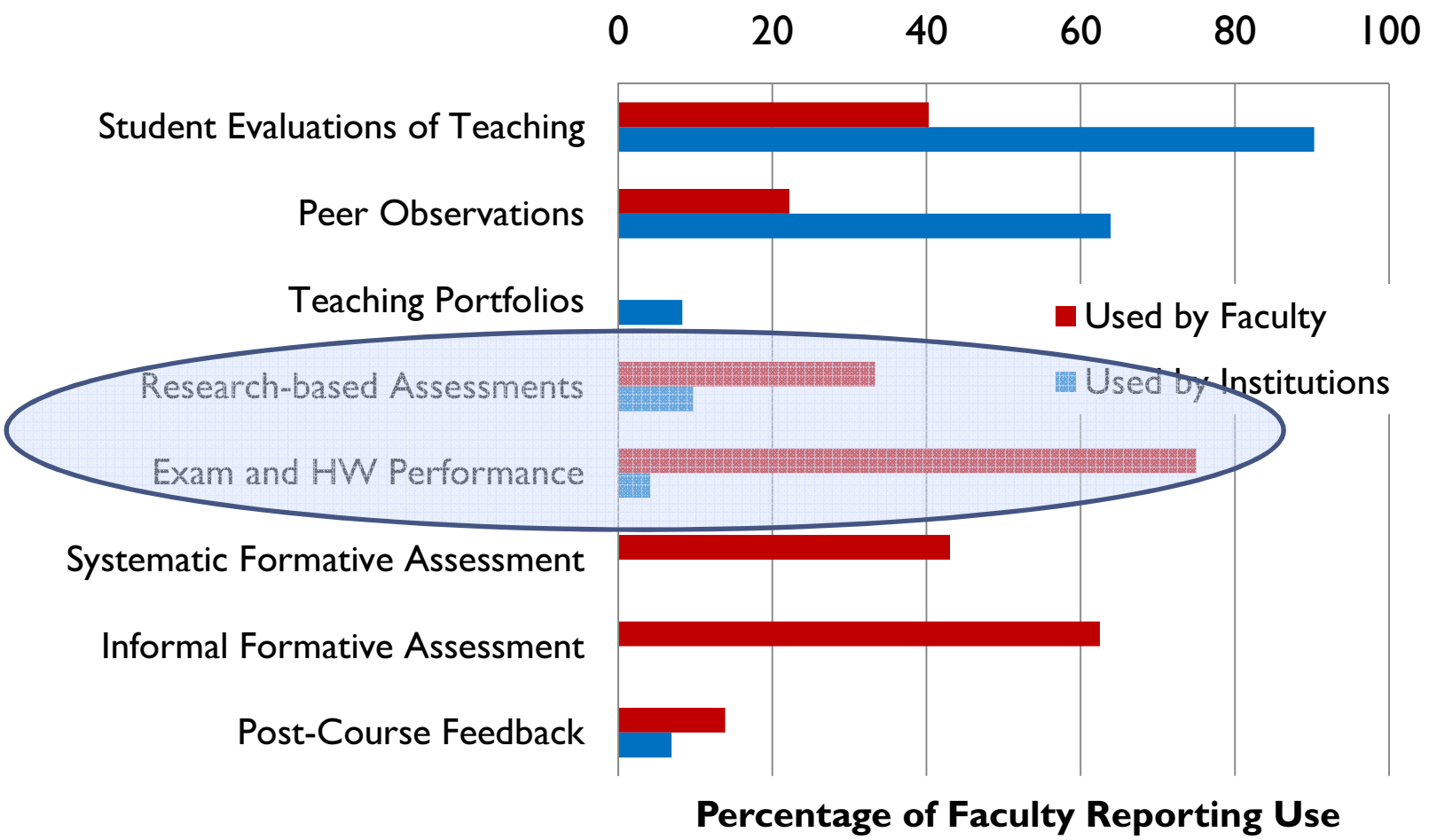
Many missed opportunities to use measures that can be summarized for higher levels.

Program Level

Actual Situation Not Well Studied

- Weak measures typically used
  - Number of graduates
  - Standardized exams for physics majors
  - Capstone experience (usually assessed informally)

Promising Opportunities



Meaningful Program Assessment Requires Faculty Input

Two Examples

- Wieman Course Transformation Model
- Marbach-Ad Research Group Model

Both involve faculty groups developing goals and measures.

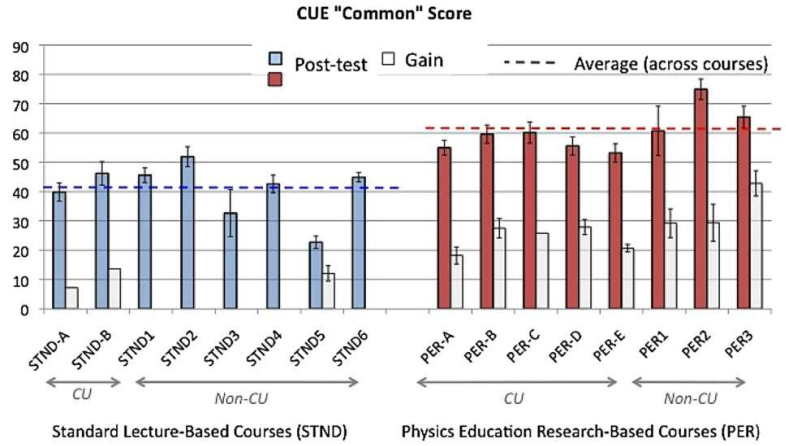
Wieman Course Transformation Model

Start with Course Level

Identify Course Goals (not topics) → Develop Assessment → Make Course Revisions → Assess

For Upper Division E&M Course, 13 instructors met 7 times to set goals. (Supported by Science Teaching Fellow)

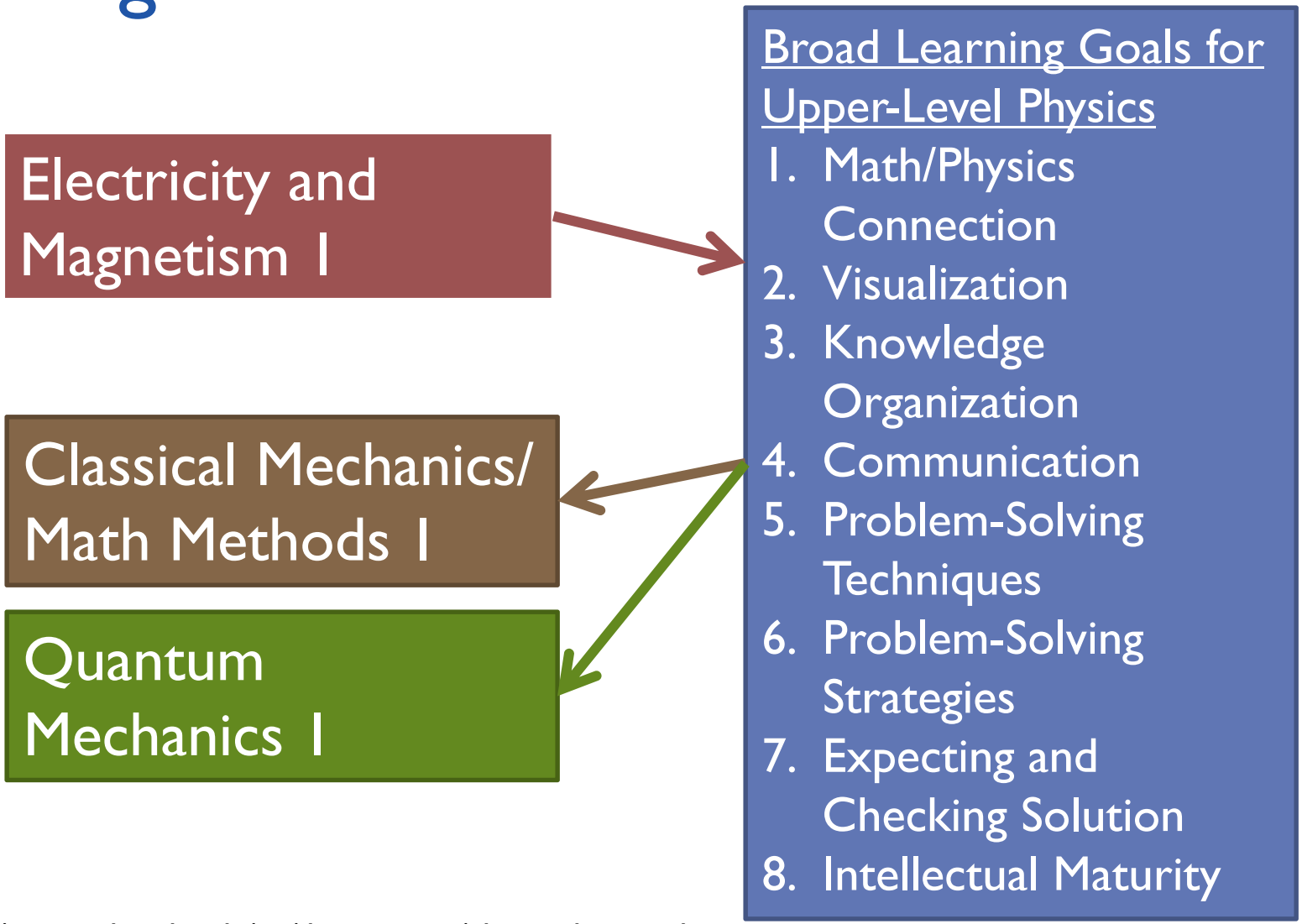
Developed diagnostic test (CUE).



Core Question: "What is junior E&M1 about? How is it different from the introductory E&M course?"

Chasteen, S.V., Pepper, R. E., Caballero, M. D., Pollock, S. J., & Perkins, K. K. (2012). Colorado Upper-Division Electrostatics diagnostic: A conceptual assessment for the junior level. *Physical Review Special Topics - Physics Education Research*, *8*(2), 020108.

Course Level Led to Broader Program Level Goals



http://www.colorado.edu/sei/departments/physics_learning.htm

Marbach-Ad Research Group Model
Start with Important Topic Area

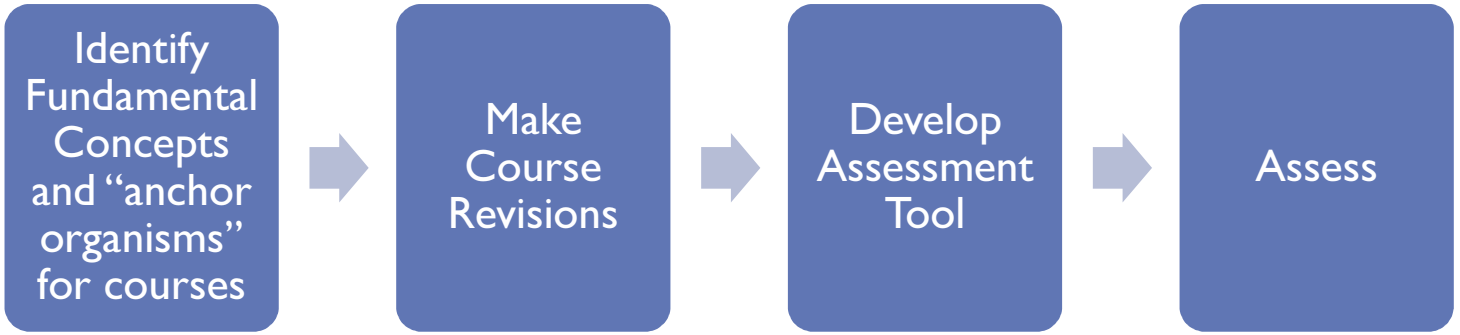
- Focus on 7 microbiology courses

Course
General Microbiology (BSCI 223)[a]
Microbial Genetics (BSCI 412)
Immunology (BSCI 422)
Immunology Laboratory (BSCI 423)
Epidemiology (BSCI 425)
Pathogenic Microbiology (BSCI 424)
Microbial Pathogenesis (BSCI 417)

<u>Goals</u>

- Minimize overlap, allow courses to build on one another
- Develop assessment tools

Marbach-Ad Research Group Model



12 instructors meet monthly. Supported by a graduate student.

Instructors change their courses and discuss experiences with group.

Core Question: "What do we want our students to truly understand and remember 5 years after they have completed our set of our courses?"

Curricular Alignment

Table 4. Example of curricular Alignment Matrix for eight of our courses and 16 questions

Question	Concept*	BSCI223	BSCI380	BSCI424	BSCI412	BSCI417	BSCI422	BSCI423	MC GM**
1	12	N/N (2/1)	No (2)	N/N (0/1)	No (0)	No (2)	No (3)	No (2)	No (3)
2	3, 4, 10	N/Y (3)	Yes (2)	N/N (2/3)	Yes (3)	Yes (3)	Yes (0)	Yes (0)	No (2)
3	2, 3	N/Y (2/3)	Yes (2)	N/N (2/3)	No (1)	Yes (3)	Yes (0)	Yes (0)	No (3)
4	3, 4, 10	N/N (3/2)	Yes (2)	Y/N (3/3)	No (3)	Yes (3)	Yes (0)	Yes (0)	No (3)
5	6	N/N (0/1)	No (2)	N/Y (0/2)	No (1)	Yes (3)	Yes (2)	Yes (1)	No (2)
6	13	N/N (2/1)	Yes (0)	?/N (0/3)	No (0)	No (2)	No (2)	No (2)	No (3)
7	10	N/N (3/1)	Yes (0)	Y/N (3/0)	No (3)	Yes (3)	Yes (0)	Yes (0)	No (3)
8	12	N/N (1/1)	No (2)	N/N (0/2)	No (0)	No (2)	No (3)	No (3)	No (2)
9	7, 1, 12	N/N (2/1)	No (2)	N/N (0/2)	No (0)	Yes (3)	No (3)	No (2)	No (3)
10	4, 5, 9, 12	N/N (3/2)	Yes (3)	?/N (2/3)	No (1)	Yes (3)	Yes (2)	Yes (0)	No (1)
11	8	N/N (2/1)	Yes (3)	?/N (2/3)	No (0)	Yes (3)	Yes (1)	Yes (0)	No (0)
12	3	N/N (2/2)	Yes (1)	?/N (2/2)	No (3)	Yes (3)	Yes (1)	Yes (0)	No (3)
13	7, 9	N/Y (2/2)	Yes (2)	Y/Y (3/3)	Yes (2)	Yes (3)	Yes (0)	Yes (0)	No (3)
14	10	N/N (2/1)	Yes (1)	?/N (2/0)	No (1)	Yes (3)	Yes (0)	Yes (0)	No (3)
15	13	N/N (2/2)	Yes (0)	N/N (0/2)	No (0)	No (2)	N/Y (3)	No (3)	No (3)
16	9, 10	N/N (2/1)	Yes (1)	N/N (3/2)	No (3)	Yes (3)	Yes (0)	Yes (0)	No (0)

For each question, instructors reported: 1) Their assumptions about student prior knowledge (Yes, No, or (?) for don't know); and 2) The level of topic coverage in their classes (0 = not at all; 1 = briefly; 2 = moderately; 3 = detailed). Two numbers or letters in one box indicates feedback from two instructors.

*The final version of the concept inventory includes additional question that covers concept 11.

**MC GM, Montgomery College General Microbiology course.

Marbach-Ad, G., McAdams, K. C., Benson, S., Briken, V., Cathcart, L., Chase, M., … Smith, A. C. (2010). A model for using a concept inventory as a tool for students' assessment and faculty professional development. *CBE Life Sciences Education*, *9*(4), 408–16. doi:10.1187/cbe.10-05-0069

Assess both Course and Program Level

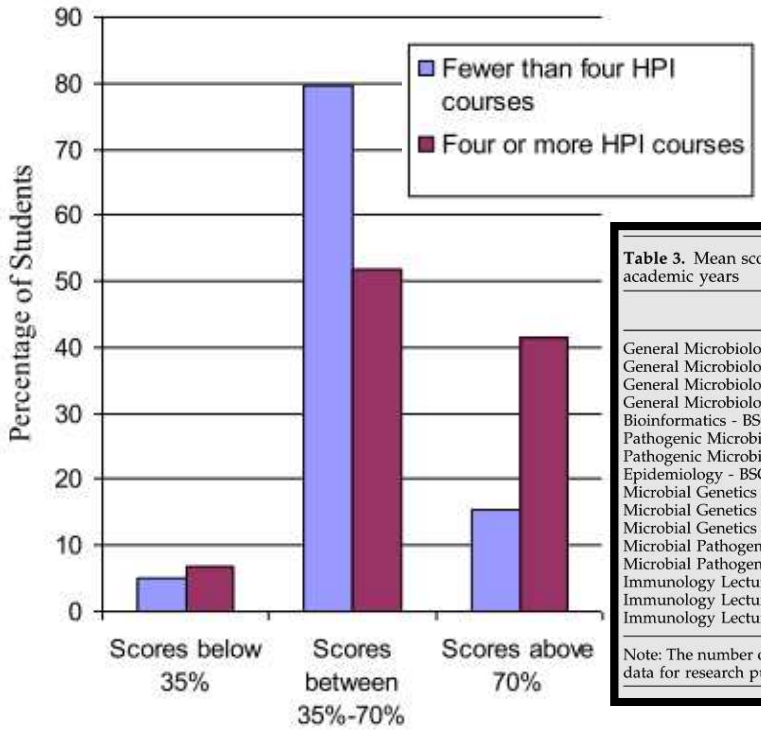


Figure 1. Concept Inventory scores according to the number of HPI course taken by the students. Based upon the Concept Inven-

Scores from each course

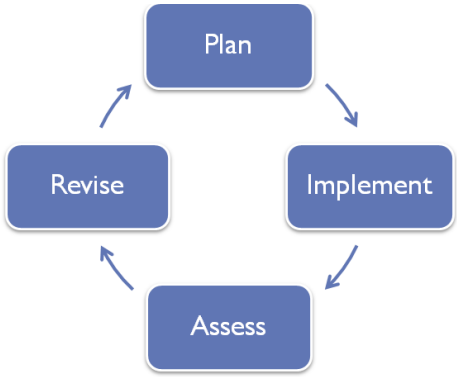
Table 3. Mean scores (out of a maximum of 100) for pre- and post-Concept Inventory scores for each course over a period of three academic years

Course	Pre	Post	Sig.
General Microbiology - BSCI 223/Fall 2006 (n = 109, 16 questions)	31.1 ± 15.6	48.1 ± 16.9	<0.001***
General Microbiology - BSCI 223/Spring 2007 (n = 127, 16 questions)	31.9 ± 15	44.2 ± 19.4	<0.001***
General Microbiology - BSCI 223/Fall 2008 (n = 90, 18 questions)	26.1 ± 15.6	47.1 ± 16.2	<0.001***
General Microbiology - BSCI 223/Spring 2009 (n = 107, 17 questions)	30.1 ± 14.8	49.1 ± 14.1	<0.001***
Bioinformatics - BSCI 380/Fall 2008 (n = 18, 18 questions)	46.3 ± 15.2	49.1 ± 14.9	0.252
Pathogenic Microbiology - BSCI 424/Fall 2006 (n = 96, 16 questions)	43.9 ± 16.9	51.1 ± 18.1	<0.001***
Pathogenic Microbiology - BSCI 424/Fall 2008 (n = 50, 18 questions)	45.2 ± 15.0	51.0 ± 13.6	<0.001***
Epidemiology - BSCI 425/Spring 2007 (n = 52, 16 questions)	44.1 ± 20.6	42.8 ± 22.5	0.606
Microbial Genetics - BSCI 412/Spring 2007 (n = 45, 16 questions)	51.4 ± 16.25	49.0 ± 20.0	0.266
Microbial Genetics - BSCI 412/Spring 2008 (n = 35, 18 questions)	53.8 ± 17.4	52.8 ± 16.6	0.72
Microbial Genetics - BSCI 412/Spring 2009 (n = 33, 17 questions)	54.0 ± 14.2	56.2 ± 18.1	0.407
Microbial Pathogenesis - BSCI 417/Spring 2008 (n = 18, 18 questions)	58.9 ± 20.4	65.0 ± 18.3	0.24
Microbial Pathogenesis - BSCI 417/Spring 2009 (n = 12, 17 questions)	51.0 ± 13.4	52.5 ± 14.3	<0.05*
Immunology Lecture - BSCI 422/Spring 2007 (n = 48, 16 questions)	59.9 ± 19.4	64.3 ± 21.9	<0.05*
Immunology Lecture - BSCI 422/Spring 2008 (n = 53, 18 questions)	53.7 ± 16.9	56.6 ± 17.8	0.132
Immunology Lecture - BSCI 422/Spring 2009 (n = 31, 17 questions)	58.8 ± 15.7	61.6 ± 16.4	0.572

Note: The number of students in this table reflects students who responded to the pre- and postsurvey and gave their permission to use this data for research purposes. *$p < .005$, ***$p < .0001$.

Marbach-Ad, G., McAdams, K. C., Benson, S., Briken, V., Cathcart, L., Chase, M., … Smith, A. C. (2010). A model for using a concept inventory as a tool for students' assessment and faculty professional development. *CBE Life Sciences Education*, *9*(4), 408–16. doi:10.1187/cbe.10-05-0069

Common Features



- Focus on Broad Learning Goals, then specific measures
  - Framed by meaningful questions:
    - What is junior E&M1 about? How is it different from the introductory E&M course?
    - What do we want our students to truly understand and remember 5 years after they have completed our set of our courses?
- Involved both course and program level goals
- Faculty Ownership and Direction
- Regular meetings (but not too intensive)
- Support (Post doc or grad student)

In These Examples

	Improve	Judge
Course	Course	Pe s: (De
Program	Program	Program Review: A nd A R esources (Department, Institution)

Assessment data (Interaction w/ Colleagues)

Summaries of student performance (over time and instructor)

Course data from different program stages

Summaries of % of students meeting goals.

Thank You

Wieman Course Transformation Model

- Chasteen, B. S.V, Perkins, K. K., Beale, P. D., Pollock, S. J., & Wieman, C. E. (2011). A Thoughtful Approach to Instruction: Course Transformation for the Rest of Us. *Journal of College Science Teaching*, *40*(4), 70–76.
- Pepper, R. E., Chasteen, S.V., Pollock, S. J., Perkins, K. K., Rebello, N. S., Engelhardt, P.V., & Singh, C. (2012). Facilitating faculty conversations: Development of consensus learning goals. In *Proceedings of the 2011 Physics Education Research Conference* (pp. 291–294). doi:10.1063/1.3680052
- Chasteen, S.V., Pepper, R. E., Caballero, M. D., Pollock, S. J., & Perkins, K. K. (2012). Colorado Upper-Division Electrostatics diagnostic: A conceptual assessment for the junior level. *Physical Review Special Topics - Physics Education Research*, *8*(2), 020108. doi:10.1103/PhysRevSTPER.8.020108
- Wieman, C. E., Perkins, K. K., & Gilbert, S. (2010). Transforming Science Education at Large Research Universities: A Case Study in Progress. *Change*, *42*(2), 6–14. Retrieved from http://www.changemag.org/Archives/Back Issues/March-April 2010/transforming-science-full.html

Marbach-Ad Research Group Model

- Marbach-Ad, G., McAdams, K. C., Benson, S., Briken, V., Cathcart, L., Chase, M., … Smith, A. C. (2010). A model for using a concept inventory as a tool for students' assessment and faculty professional development. *CBE Life Sciences Education*, *9*(4), 408–16. doi:10.1187/cbe.10-05-0069
- Marbach-Ad, G., Briken, V., Frauwirth, K., Gao, L.-Y., Hutcheson, S. W., Joseph, S. W., … Smith, A. C. (2007). A faculty team works to create content linkages among various courses to increase meaningful learning of targeted concepts of microbiology. *CBE Life Sciences Education*, *6*(2), 155–62. doi:10.1187/cbe.06-12-0212