CU’s Science Education Initiative (SEI) has as its goals to engage and support faculty in applying a scholarly-approach to teaching, and ultimately, to achieve sustainable institutional change towards effective, evidence-based science education. The program funds departments to take a four-step, scientific approach to undergraduate education:

1. Establish what students should learn;
2. Scientifically measure what students are actually learning;
3. Use instructional approaches guided by research on learning and measures of student learning;
4. Disseminate and adopt what works.

The SEI is a 5 year initiative (2006-2011), funded by President Benson and Chancellor DiStefano.

CU SEI Model of Course Transformation

Develop/adapt curricular materials and teaching approaches that are supported by research and aligned with learning goals

- Teaching approaches that actively engage students
- Align with findings from research on learning:
  - Building on prior knowledge
  - Focusing on sense-making, reasoning, conceptual framing
  - Developing metacognitive skills
  - Promoting more and more effective student practice towards expertise
- Consistent across course elements – lecture, homework, exams
- Guided by knowledge of student thinking

Identify/develop consensus learning goals

- Through faculty discussions
- Shift from topics to explicit measurable learning goals and outcomes
  “What should students be able to do at the end of the course?”
- Includes skills, attitudinal, metacognitive goals
- Develop assessments to measure achievement of learning goals

Use data to support and guide faculty efforts

- Probe student thinking about and learning of:
  - Content.
  - Beliefs about the discipline and learning in the discipline.
  - Course structures for learning, study behavior, enjoyment, etc.

- Methodologies used:
  - Student interviews and focus groups
  - Classroom/recitation observations
  - Analysis of student work
  - Conceptual pre/post assessment
  - Belief and course feedback surveys

What should students learn?

Science Teaching Fellows (STFs) & Faculty

Which instructional approaches improve student learning?

What are students learning?

SEI Involvement

- CHEM, GEOL, IPHY, MCDB, PHYS
  - propose for funding
  - define their activities (among those fundable)
  - hire local resources:
    - Science Teaching Fellows (STFs)
    - faculty transform courses with STF assistance
  - report on activities to SEI central
  - publish findings in scholarly journals

Many courses impacted

Efforts are impacting >10,000 student-courses/yr

Faculty involvement after 3 years (out of 127)

- 65% have modified their teaching
- 48% added clicker questions
- 75% involved in defining learning goals
- 47% use SEI-facilitated learning goals
- 53% involved in creating course assessments (conceptual, tied to learning goals, validated)
- 48% use course assessment tools

Faculty report:

- More discussions about teaching
- More intellectual reward from teaching
- More enjoyment of teaching

Overview & Structure

Why invest in an SEI?

- Logical unit of change is the Department
  - Department is the cultural unit. Need change to involve majority of faculty in department.
- Change must be driven by department
  - Faculty are experts in their science fields. The faculty and department as a whole need to: decide what students should learn; adopt or develop good measures of relevant learning; and change instructional approaches.
- Evidence is key
  - Science faculty value data – including data on student thinking, learning, attitudes, and perceptions.
- Resources needed to support process of change – These changes take faculty time.
- Effective teaching can be more efficient and more fun! Re-use of good materials, less repetition/overlap of material, effective use of technology, etc. can result in lower resource requirements in long-term. And faculty report teaching is more fun.

Significant faculty involvement

Use of SEI-funded resources by faculty

- Significant
- Casual

Number of Courses

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SEI Involvement

- Consult (15)
- Partial (10)
- Full (23)