The CU Science Education Initiative: Examining the Model and its Impact

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The Science Education Initiative: An experiment in Course, Faculty & Institutional Change

- 8-year, $5M university-funded program
- Included 7 departments
- Experiment to test a model of change in STEM education: Is it possible to scale-up the use of research-based techniques at a university so that they become the norm?
- Sister program at University of British Columbia (http://cwsse.ubc.ca)

Features of the SEI Model of Change

- Focus on department as unit of change¹,²
- Competitive grant program with departmentally-submitted proposals
- Bulk of funding used to hire postdoctoral Science Teaching Fellows (STFs) to oversee course transformation
- STFs have PhD in discipline, an interest in education, and work at departmental level

Model of Course Transformation

- Develop learning goals in consensus with faculty
- Post-docs and Faculty
- Characterize common student difficulties
- Use research-based instructional approaches to improve student learning
- Which instructional approaches improve student learning?

- Based on Backwards Design model
- Ideally, starting with large introductory courses
- First, develop course learning goals
- Then, develop instructional approaches
- Use goals, research on student learning, to drive reforms

For more information, publications, videos and course resources:
http://colorado.edu/sei
And look for upcoming papers on outcomes of the SEI

References
5. PRST-PER Upper-Division collection, in progress
6. Overall impact of the Science Education Initiative; paper in progress

Structural components: What works?

The target of change: Course & Faculty Development

- Introductory courses are particularly tricky to transform
- Consensus learning goals are difficult, and hard to get traction with faculty
- A course development model is sometimes subsumed by a faculty development model due to lack of traction
- Faculty typically take ~2 years to “change”
- Student outcome data is not typically a compelling factor for faculty to change; student engagement often is.

The agents of change: Postdoctoral STFs

- Provide important resource of time, coaching, and institutional memory; i.e., archiving
- STF training & community is critical
- Selection of the STF is important; respectful, timely, solicitous, scholarly
- Publication rate varies widely; motivations vary by STF and department
- Who do they work for? Requires clear establishment of STF role as departmental staff, within departmental structure, but funded by SEI.

The purveyors of change: Departments & Administration

- Lack of departmental ownership of courses and course goals is a major challenge to self-sustaining course reform
- Accountability and commitment to change are problematic; “we can’t tell our faculty how to teach.”
- Lack of institutional incentives for teaching remains a dominant barrier
- Selection of “friendly” department chairs affects departmental success
- Selection of “friendly” teaching faculty is important for sustainability of a course

Lessons learned

Departmental focus with STF support led to substantial and long-lasting change

- Degree of success depends strongly on departmental culture & organizational structure (e.g., faculty course ownership or rotation, teaching approach, interests of departmental chair)
- Money helps. At UBC, twice the funding per department allowed for greater SEI Central and departmental staff time, as well as faculty incentives.
- Beginning with large-enrollment introductory courses and development of learning goals may be ill-advised
- Targeting early small, impactful and motivating interventions likely generates more momentum, providing catalyst for change.

Oversight from SEI administration is important for providing:
- Clear expectations and oversight of STFs and departments
- Formal, sustained STF training
- Community-building among sizeable STF cohort
- Proposal process with required deliverables and commitments (e.g., specific courses and teaching assignments).
- Departmental accountability (e.g., real consequences for lack of follow-through in terms of funding & higher administration)

The impact: What happened?

Faculty impact

- 135 faculty have modified their teaching (~50% of faculty); 93 added clickers, and 93 added other forms of interactive engagement
- Departments with frequent faculty rotations face sustainability issues, but impact more faculty
- In Physics, 80% of faculty use materials

Course Impact

- Cost ~ $145K per course
- Physics focused on upper-division; all but one core upper-division majors course remains untouched
- In Physics, most commonly used are clickers, homework, tutorials and learning goals; JiTT questions and exams are least used.

Student impact

- Average of ~20,000 students/year
- In Physics, 92% of majors service load in impacted courses (from SEI and prior effort)
- Note: Not all SEI-affected courses maintain those changes
- Demonstrated student learning improvements in Physics and Biology
- Assessment tools available for 51 courses

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