Department-based Science Education Specialists as agents of change in university education

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Barriers

Science Education Specialists (SESs) Agents of Change

An SES:
- Is expert in particular science discipline (usually recent PhD)
- Hired by science department
- Given crash course in science education fundamentals (by SEI central)
- Has considerable ongoing interactions with and professional development through SEI central & community of SESs
- Works with faculty to develop learning goals, measure learning, change assessment & instruction...

Examples of Change
- Extensive use of “faculty working groups”
  - A group of faculty with interest in a particular course meet to define learning goals, share resources, input into assessment measures, etc.
- Typically meet biweekly or monthly. Some summertime intensive meetings (2 days)
- Movement of content out of an over-crowded CU Chem 1 into Chem 2
- UBC Computer Science learning goals for 5 courses. CU MCD-Biology is developing and aligning learning goals for entire core curriculum.
- Widespread usage of pre/post tests and end-of-term surveys in courses throughout participating departments.
- CU: 14 courses with new pre/post conceptual content surveys (5 courses using pre-post prior to SEI)
- 5 CU and 5 UBC using surveys of student beliefs about discipline and learning
- Some faculty posting explicit learning goals to students.
- UBC and CU assessments of usefulness of learning goals for students and faculty.

Collect, distill, and communicate data to support and guide faculty efforts

- Probe student thinking about and learning of:
  - Content – specifically faculty-identified learning goals.
  - Beliefs about the discipline and learning in the discipline.
  - Usefulness of various course structures for learning, study behavior, enjoyment of various aspects of course, etc.

Methodologies used:
- Student interviews and focus groups
- Classroom or recitation observations
- Analysis of clicker questions, group work, homework, and exam responses
- Conceptual assessment pre/post surveys
- In-class and online belief/student feedback surveys

Examples of Change
- Introduction of “optional co-seminar course” in CU MCD-Biology due to evidence of improved performance of groups doing recitation-type activity.
- Introduction of many more visualizations and more connections to the real-world in CU’s general chemistry due to poor performance on content questions / CLASS survey – result = improvement in performance
- Introduction of homework (CU anatomy, physiology, intro geoscience) in several courses, in response to student feedback on need for homework.

Examples of Change
- Tutorial activities created for several different courses (e.g. general chemistry 1&2, upper-division physics, environmental geochemistry, etc.)
- New collections of clicker questions in numerous courses
- Use of PeerWise® online collaborative multiple choice question repository (students write/take/grade questions) in UBC Computer Science Dept.
- Calibrated Peer Review® introduced in CU Integrative Physiology
- White boarding activities introduced in upper-division physics.
- Introduction of learning assistants (CU LA program) in CU Chemistry and Biology recitations

Examples of Change
- Large number of faculty formal and informal interactions with SESs
- Some faculty experimenting with research-based teaching practices with only minimal support from SEIs (examples in CU’s IPHY or MCDB and UBC’s EOS and CS dept.)
- Number one request of faculty responding to survey on SEI efforts: “When can I partner with an SES on my course?”

Develop curricular materials and teaching approaches in collaboration with faculty

Serve as a local resource for faculty

- New curricular material development. Three approaches – best one depends on context and faculty:
  - Primary development by SES with faculty input/feedback
  - Co-development by SES and faculty
  - Primary development by faculty with SES input/feedback
- Facilitating new course structures or teaching approaches (e.g. restructuring recitations, introducing clickers, adding in-class tutorials, using homework, ...

Examples of Change
- On-going development of SEI Archive software development at UBC
- Both physical and electronic binders of materials in CU integrative physiology. Compilation and organization of faculty collections of homeworks in upper-division physics. Compilation of CU intro geology materials contributed from numerous faculty and redistribution.
- Develop and implemented TA training program in CU chemistry and UBC EOS.

Facilitate sustainability by archiving and disseminating

- Compile/Organize resources:
  - Learning goals, lecture notes, homeworks, assessments, ...
  - Notes on student difficulties/thinking
  - Results of assessments of learning and surveys
- Annotate resources with notes on student thinking and important implementation details
- Establish supporting structures
- Disseminate materials:
  - To their departmental faculty directly
  - To department and broader community via UBC CWSEI web-based archive
- Publish in discipline-based education journals

Facilitating Factors

University or cross-departmental structures:
- Support at highest administrative levels
- Synergistic education-related efforts, e.g.
  - CU learning assistant program
  - Discipline-based education research group
  - Ties with school of education
- Multi-departmental effort – community of SESs

Department:
- Supportive Chair – values SEI project & raises its profile
- Broad departmental support
- Senior & junior faculty leaders/promoters for project
- Prior education reforms in department (e.g. tutorials in physics)
- SES viewed as member of the faculty
  - Attends faculty meeting, report on SEI
  - Attends colloquium
  - Good visibility – central office
- Rewards for teaching
- Newly-formed department in need of new curriculum
- Classroom space for tutorial-style group work

Faculty:
- Faculty who are satisfied with student learning
- SES talking to faculty early and often – establishing a good working relationship

Course:
- Standard accepted curriculum
- Multiple faculty on same course – can also be barrier.
- Recitation section for implementing active learning
- Availability of TAs

SES job:
- Good interpersonal and conflict resolution skills
- Presenting results of research to faculty

Department:
- An unsupportive or inactive department chair
- SESs not integrated into department operation
- Departmental culture that...
  - Prioritizes research and/or graduate education over undergraduate education
  - Views education research as less scholarly
  - Expect full academic freedom in teaching
- Lack of reward structure for faculty efforts on education
- University credit-hour limitations for majors
- Lack of teaching plan – last-minute teaching assignments

Faculty:
- Other time demands
- Getting faculty to understand the underlying pedagogy
- Where students about teaching and learning are strong and inconsistent with SEI goals
- Low opinion of students

Course-specific:
- Multi-section courses (5 sections / 5 faculty)
  - (or multiple faculty on same course – can also be facilitating).
- Non-standardized curriculum
- Barriers to content adjustment/enhancement
- Students who dislike new teaching approaches; poor FCQs

1http://peerwise.cs.auckland.ac.nz/  2http://cpr.molsci.ucla.edu/