Talks

Overview of CWSEI progress — Sarah Gilbert, CWSEI Acting Director

Faculty Experiences:
Georg Rieger (Physics)
Susan Allen (Oceanography)
Gary Bradfield (Ecology)
Mark MacLean (Mathematics)

Poster session 11am-1:30pm room 261
Details on what’s happening (& food)

1:30 – 2:50pm, room 182 – Example Class followed by discussion
lead by Harvey Richer

Workshops:
3:00 – 4:30pm, room 185 – Designing in-class activities
3:00 – 4:30pm, room 260 – Effective Peer Instruction using clickers
CWSEI “Trinity” for each course

1\textsuperscript{st}: Learning goals. (what should students be able to \textit{do}?)

2\textsuperscript{nd}: Good assessment (validated tests)

3\textsuperscript{rd}: Improved teaching methods (\textit{research based, improve learning})

Materials, assessment tools, homework, notes ... saved, reused, improved.

\textit{Making teaching more effective, and more rewarding for faculty and students}
Carl Wieman Science Education Initiative
Started 4 years ago ⇒ goal is widespread improvement in science education at UBC, focusing on department level.

CWSEI Programs at various scales and stages:

Large scale & in later stage – Earth & Ocean Sciences
Large & Medium scale at earlier stages:
  Physics & Astronomy
  Mathematics
  Computer Science
  Life Sciences

Smaller scale programs – Chemistry, Statistics

$2 M gift from David Cheriton for Math and Computer Sci.
Overview of Progress (More details in talks & posters)

Earth & Ocean Sciences
STLFs: Francis Jones, Brett Gilley, Erin Lane, & Josh Caulkins; CWSEI Dept. Director: Sara Harris

• About 60% of faculty have made significant changes to teaching.

• 20 courses undergoing or completed transformation plus another 10 improved with SEI help

• Typical new things:
  o clearly articulated learning goals for students & faculty
  o pre-reading assignments & quizzes
  o clicker questions and peer discussion
  o worksheets & in-class group activities
  o 2-stage exams (individual + group)
  o team projects
  o pre-post testing to measure learning, ...

much more active learning and feedback
<table>
<thead>
<tr>
<th>COURSE</th>
<th>LEARNING GOALS</th>
<th>NEW ASSESSMENTS</th>
<th>IMPROVED METHODS</th>
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<tbody>
<tr>
<td>EOSC 211: Computer Methods in Earth, Ocean &amp; Atmosph. Sciences (Jan '09 start)</td>
<td>Course-level goals: complete</td>
<td>Pre-post assessment: Administered in Teach 1 and edited for Teach 2, can be used “as is” for all future terms</td>
<td>In-class worksheets for every lecture</td>
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<td></td>
<td>Lecture-level goals: complete</td>
<td>Midterm and end-of-term surveys</td>
<td>Pair-programming used in all labs and assignments.</td>
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<td></td>
<td>Learning goals for Labs/Assignments: draft</td>
<td>New types of exam questions based on computer science concepts</td>
<td>Name-sticks used to call on students during lectures and in-class discussions</td>
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<td>Post-lecture Interviews</td>
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<td>Lab interviews</td>
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<tr>
<td>EOSC 212: Topics in the Earth &amp; Planetary Sciences (Jan '08 start)</td>
<td>Course-level goals: complete</td>
<td>End-of-term survey for project evaluation</td>
<td>Vista Course Management System used extensively for content delivery, quizzing, surveying, logistics.</td>
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<td>Focus is on science thinking skills rather than content</td>
<td>Quizzes on readings for both individual and teams, using Team Based Learning strategies</td>
<td>Team Based Learning elements: permanent teams, individual/team quiz protocols &amp; in-class team activities</td>
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<td>Two projects (presentation and poster), including feedback at multiple stages of delivery</td>
<td>Content from Scientific American and other articles and lectures</td>
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<td>Pre-post test related to model-based reasoning</td>
<td>Three modules chosen to highlight Departmental research strengths</td>
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Final transformation term was Fall'09, but further refinements of generic science thinking activities and assessments were...
Susan Allen talk about her experience transforming Oceanography courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Course-level goals: complete</th>
<th>Mid-term survey</th>
<th>Widespread use of thought-provoking clicker questions</th>
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<tbody>
<tr>
<td>EOSC 372: Introductory Oceanography: Circulation and Plankton (Jan '09 start)</td>
<td>Lecture-level goals: complete</td>
<td>End-of-term survey</td>
<td>Daily assignments with online quizzes</td>
</tr>
<tr>
<td>Faculty: S. Allen, K. Orlins, M. Maldonado, E. Lane</td>
<td>Assignment learning goals: complete</td>
<td>Daily online quizzes</td>
<td>In class demonstrations and analogies developed</td>
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<tr>
<td>STLFl: Erin Lane</td>
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<td>Pre-requisite knowledge diagnostic quiz</td>
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<td>Draft post test</td>
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<td>Student workloads questions</td>
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<tr>
<td>EOSC 373: Introductory Oceanography: Climate and Ecosystems (Sept '09 start)</td>
<td>Lecture-level goals: complete</td>
<td>Mid-term survey</td>
<td>Widespread use of thought-provoking clicker questions</td>
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<tr>
<td>Faculty: M. Maldonado, S. Allen, R. Francois, E. Lane</td>
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<td>Draft diagnostic test</td>
<td>Daily assignments with online quizzes</td>
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<tr>
<td>STLFl: Erin Lane</td>
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<tr>
<td>EOSC 472: Introduction to Marine Chemistry and Geochemistry (Sep '09 start)</td>
<td>Course-level goals: complete, editing for new content</td>
<td>Midterm and end-of-term surveys</td>
<td>Weekly worksheet activities</td>
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<tr>
<td>Faculty: K. Orians</td>
<td>Lecture-level goals: draft, editing for new content</td>
<td>Reading quizzes introduced</td>
<td>Anonymous peer-reviewed writing assignment with instructor feedback</td>
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<td>STLFl: Joshua Caulkins</td>
<td>Term papers enhanced to be a “critical review paper” which includes greater depth of comprehension</td>
<td>Reworked homework sets</td>
<td>Post-lecture student interviews</td>
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<td>Investigating new textbook options, perhaps introducing a packet of articles</td>
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<td>name sticks used during lectures</td>
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Physics & Astronomy

STLFs: Louis Deslauriers, James Day, Jim Carolan, Cynthia Heiner, Peter Newbury, & Ido Roll; CWSEI Dept. Director: Mona Berciu

- Astronomy courses – *Exploring the Universe I & II*
  Harvey Richer example class at 1:30pm in this room

- Intro Physics courses: *Phys 100, 101, 102, 107, 109, 153*
  Georg Rieger talk about his experience transforming courses

- Higher level Physics courses: *Phys 200, 250, 304, 408, 450*

- Some courses have no lectures anymore
  Workshop on designing activities this afternoon at 3:00pm;
  David Jones will be sharing his experience transforming Phys 408
Mini-transformation in Physics 153 (Electromagnetic Waves topic)

Score on test

Number of students

Control group

Experiment group

Status: Accepted for publication in Science

Results inspired department to do full transformation of course

Mini-transformations in Phys 102 in Spring 2011
Life Sciences

STLFs: Jared Taylor & Malin Hansen; 
CWSEI Dept. Director: George Spiegelman

• BIOL 112 – Cell Biology

*Invention activities, investigation activities, In-class writing assignments, clicker questions & peer discussion, …*

Coming up with plausible mechanisms for biological process student never encountered before:

![Graph showing data comparison]

Published in CBE-Life Sciences Education

Selected for inclusion in the 2010 Highlights issue
Ecology courses BIOL 304 & 306
Fundamentals of Ecology and Advanced Ecology redesigned around the questions:

- Why do species differ in their population dynamics?
- How do species coexist?
- Are communities stable?
- Are humans reducing the ecosystem services on which we depend?

Gary Bradfield talk about his experience transforming Biol 306 – Advanced Ecology
Mathematics

STLFs: Warren Code, Joseph Lo, & Sandi Merchant; CWSEI Dept. Director: Costanza Piccolo

• Calculus courses – MATH 110, 104/184, 180/184 workshops
  Major effort in MATH 104/184 (Differential Calculus with Applications to Commerce and Social Sciences)
  Mark MacLean will talk about what they did and how it went

• Computing/computer lab components – Math 152, 256 (Mech 221), 257/316, 253 (Mech 222), & Math 307

• Mathematical Proof – Math 220
  Developed pre-post test for basic proof skills, conducting student interviews, discovering interesting student thinking about proofs

• Mathematical Models in Science – MATH 360 (new course)

• Mathematics Attitudes Perceptions Survey under development

6 posters on above projects
• Dependence on procedures
  *e.g.* To learn math, I only need to memorize solutions to sample problems.

• Need to understand formulas or procedures
  *e.g.* In math, it is important for me to make sense out of formulas and procedures before I can use them correctly.

• Relation to real world
  *e.g.* Learning math changes my ideas about how the world works.

• Exploration in problems solving
  *e.g.* There are times I solve a math problem more than one way to help my understanding.

• Confidence
  *e.g.* If I get stuck on a math problem, there is no chance that I will figure it out on my own.

• Independence in learning
  *e.g.* I cannot learn math if the teacher does not explain things well in class.
Computer Science
STLFs: Ryan Golbeck & Allison Tew; CWSEI Dept. Director: Paul Carter

• Software Practices Stream – CPSC 110, 210, 310, 410
  Helping with new CPSC 110 & 210

Longitudinal study
  measure how student knowledge develops and how well that knowledge is retained across a series of courses in their curriculum (measuring the progress towards expertise)
  • Interviewed faculty
  • Analyzed course learning goals
  • Working to develop and pilot the instruments

• A number of smaller & ongoing projects
  See posters by Kim Voll & Andre Malan and Elizabeth Patitsas & Steve Wolfman for a sample
Chemistry

Large first year labs – CHEM 121 & 123
Jennifer Duis, Sophia Nussbaum, Laurel Schafer, Jackie Stewart

• Develop laboratory learning goals

• Developed & validated 9 instruments to measure laboratory learning
  Uncovered areas of difficulty and misconceptions
  Data to direct targeted enhancements

• Increased knowledge of incoming student background
• Data supporting student appreciation of learning goals
• Improved student attitude/perception agreement with experts
• Insight into employer, faculty and student impressions of UBC laboratory skills

• Undergraduate Research Assistants – significant involvement
  Student researchers learned to:
  1) Design and/or revise/validate educational research tools (eg. surveys)
  2) Collect and manage large data sets (n = 1000)
  3) Code and statistically evaluate data using various statistical methods
  4) Interpret and present their results in written and oral formats
** see posters**
Lots of great progress - talks & posters give more details

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