

Emerging Geoscience Education Research (GER) at the University of British Columbia. AGU, December 2009

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History & Inception; Fertile Ground & Catalyst

What **prior conditions** enabled development of a GER capacity?
 What **events sparked** the start of GER at UBC ??

Fertile ground for inception of GER includes ...

The Institution (UBC)

- Learning, a pillar in UBC's Trek2010 Vision (1).
- TAG – UBC's Teaching and Academic Growth resource (2).
- Faculty Certificate Program on Higher Ed Teaching & Learning (3).
- SkyLight: a research-focused unit at the Faculty of Science (4).
- Proactive & visible support of student learning – eg LEAP at (5).

The Department; Earth and Ocean Sciences (EOS)

- 10-year Academic Plan (6); and 2005 external Dep't review (7).
- 10% of tenured faculty have a teaching-focused mandate.
- Innovations: Contributors to Science-1 (8), Integrated Sciences (9), Environmental Sciences (10); use of TBL, clickers etc ...
- Internal culture has been consistent with curriculum reform (11).
 Egs: Attention to student skill & values development ; learning-centered curricula; constructivist pedagogies.

Catalysts that kick-started GER were ...

Sense of urgency (12): history (above) & institutional challenge to reform undergraduate education (CWSEI).

CWSEI: See (13) "A new model for post-secondary education, the Optimized University", C. Wieman.

- "A five-year, \$12M project at UBC to dramatically improve undergraduate science education" (14)
- Goal: "achieve highly effective, evidence-based science education for all students by applying the latest advances in pedagogical and organizational excellence."
 - What **should** students learn (needs & goals) ??
 - What **are** students **actually** learning (assess, measure, evaluate)
 - Improve** student learning (active learning, feedback, learning skills, metacognition, solo / group, etc...)
- Also: account for practicalities and "how *instructors* change".
- Finally: provide expertise on how people learn and science education.

The model for change at EOS

- Department-wide approval of a project proposal (7) which defines how the Department will implement the above 3 CWSEI goals.
- Hire 4 full time **Science Teaching & Learning Fellows (STLFs)**.
- Collaborate & learn with colleagues across disciplines.
- Support from Sci / Ed expertise of C. Wieman and S. Gilbert.

STLFs as "Agents of Change": their mandate is to support institutional change towards evidence-based practice in undergraduate science education.



Development & Sustainability; Growth & Maturity

What are components that **fostered growth**, and **indicate maturity**, of our Geoscience Education Research capability ??

Growth; keys to progress towards critical mass for GER at UBC:

CWSEI fundamental practices (14)

- Use, Generate, Disseminate** research on learning, & avoid re-invention.
- Sustainability**: Changes to best practices must persist into the future.
- Time / resources** for scholarly practice.
- Community development**: Consulting for research faculty, use SciEd literature, bring in expert visitors, run events, produce publications and presentations, collaboration with STLFs and other colleagues, etc ...

STLF model for education research & reform (15) and (16)

- STLF's background**: Geosci. PhD or MSc with Sci. Ed. interests
- Typical duties** are to ...
 - Facilitate communication and consensus building
 - Collaborate with faculty to develop materials and teaching approaches
 - Serve as a local resource for faculty
 - Collect / distill / communicate data to support and guide faculty efforts
 - Ensure sustainability by archiving and disseminating
- Barriers & Facilitating** factors are in (15) & (16)



Active learning: Frequent feedback: Responsive to needs: Measurement of effectiveness.

Our maturing GER program includes ...

CWSEI influences

- Broad dissemination** of outcomes, including public & private archiving of materials, strategies, practices, challenges (17)
- Resources website** (eg summaries of key articles, etc.) (18)

Sustaining GER

- Institutional** support for SoTL activities (see "Fertile ground" above.)
- Department-level** leadership
 - Especially by teaching-focused faculty.
 - Strong support by the Dep't Head
 - New teaching assistant training course (29)
- Publications** – Since 2007 in our Dep't ...
 - >10 Conference contributions & workshops;
 - 2 U.Grad theses on GER;
 - 5 Articles in preparation.
- Geoscience community** support
 - This session ! And others. (GSA 2009 → 27 sessions on Geosci. Educ.)
 - Visibility: disseminate GER in specialist journals. Eg EOS.
 - Workshops, eg The Cutting Edge (19)
 - Outreach components on grants
 - Incorporate evidence-based practices in all your teaching. (i.e. treat teaching as you would your research !)

Programmatic & Research Results

What evidence is there that **science education reform** and **geoscience education research** is emerging at UBC ??

Science Education Improvement Program results so far:

Science education reform: Results

- To date, **70% of faculty** involved; **20 courses** transformed or in progress (20)
- Curriculum**: research (21) & initial recommendations approved Apr'09. (22)
- Both Graduate and Undergraduate students are participating.
- Student attitudes** about the geosciences– SAESS project (23)

Geoscience education research: Indicators of growth (Details in (24))

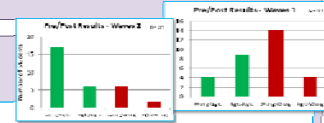
- Undergraduate** theses (below)
- Faculty** self-propelled education innovations (although no "research" as yet)
- Longitudinal** commitments - eg Exit Survey of graduating students.
- Graduate students** (future academics !) are participating in, and initiating, GER

Example of how research emerges: An honors thesis evolved from one summer student's work with (i) a previous undergraduate GER honors thesis (28), (ii) attitudes survey results (23), (iii) our course transformation results (20).

Geoscience Education Research Results; A few examples of many projects:

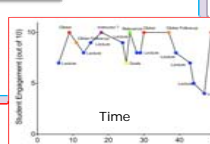
Pre-post Testing: what works and what doesn't work (26)

Question: How best to design and utilize before- and after-course testing?
Method: Several pre-post tests were implemented in a first year lab course.
Results: Positive and negative results help build tests that are useful to both students and instructors.



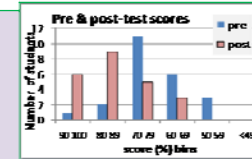
A Quantitative Classroom Observation Protocol (25)

Question: How does instruction change student engagement?
Method: A reliable, reproducible, protocol for observing students during various types of classes.
Results: Instructors modify content, pacing, active learning to keep engagement high. Paper in progress.



Promoting and Measuring Scientific Thinking Skills (27)

Question: How can we support the learning of, and measure, skills related to "scientific thinking"?
Method: Develop question-posing, reading, abstract-writing, & model based reasoning (MBR) activities, rubrics, and pre-post tests.
Results: MBR pre-post shows significant improvement. Analysis of other components is in progress.



Undergraduate thesis topics

2009: "Understanding Geological Time: A Proposed Assessment Mechanism for Beginner and Advanced Geology Students at UBC" (28)
2010: "Timescales of Landscape Formation: Student Knowledge & Confidence" in progress.

References

References (1) through (29) are attached. Please email <fjones@eos.ubc.ca> for a copy of the poster with the complete list of pointers and citations.
 We thank the staff at CWSEI and the faculty, graduate students and undergraduates in UBC's Department of Earth and Ocean Sciences who have embraced the project aims with energy and enthusiasm.