

Evolving Educational Culture in EOAS: Toward Transformative Learning

What does transformative education look like? What is the nature of effective learning opportunities, and what are the ideal roles of university scientists in teaching? How do we enable continued iteration toward better teaching and learning over time? In Earth, Ocean and Atmospheric Sciences (EOAS), we are now seven years into a department-wide effort to act on the answers to these questions, and we are looking toward better answers, and actions, in the future.

In 2007, EOAS became the first department to be funded by UBC's then-new Carl Wieman Science Education Initiative (CWSEI) when we launched the Earth & Ocean Sciences Science Education Initiative (EOS-SEI). The aims of CWSEI are ambitious – to fundamentally transform science education using evidence about how people learn. The cornerstones of this approach involve three questions: what *should* students learn? What *instructional approaches improve* student learning? And what *are* students learning? These are questions to revisit often, with answers that can evolve with emerging knowledge and changing settings. The answers are best informed by evidence-based research on learning, from which we borrow, and to which we contribute – a process entirely analogous to the way scientific research works (Wieman, 2007). The larger goal is one of ongoing and thoughtful evolution of teaching and learning culture, with outcomes for students taking top priority.

The state of education in any department depends upon local cultural norms surrounding teaching and learning. What are our expectations of ourselves and our colleagues? What are faculty expectations of students, and student expectations of faculty? Traditional approaches to science education – typified by an expert delivering content to listeners – have been shown to be less useful for learning than instructional strategies that emphasize student action (e.g. Henderson et al., 2011). More effective roles for faculty are as experts who design and facilitate opportunities for students to grapple with complex concepts, who can help as students build and refine their own mental models. It is these roles for faculty and students toward which EOAS is moving. Thirty-eight courses have been transformed so far, and use of research-based instructional strategies is now common. Students recognize the value for their learning, have come to expect to actively participate, and increasingly advocate for their own learning.



One example of "transformative learning": this large "lecture" style class does not look like a normal lecture! Students are actively engaging with interesting and challenging concepts, with instructors circulating and following up in ways that provide feedback to all students. Some normal lecturing does occur, but students are primed and ready to listen when the time comes. This practice, used in every lesson, is even carried over into midterm and final tests in the form of two-stage exams. See <http://blogs.ubc.ca/wpvc/> for short annotated video demonstrations of these and other strategies in action in real classes.

One key to the success of EOS-SEI has been hiring full time “Science Teaching and Learning Fellows” (STLFs). These people have relevant scientific expertise as well as a demonstrated commitment to applying and conducting discipline based education research. Faculty members and STLFs work together to choose, modify, implement and assess evidence-based strategies for each unique setting. They have incorporated active learning in classes, addressed the practical challenges of new approaches to teaching, designed measures of student learning and student perceptions, gathered evidence of learning, and shared their successes and failures with the larger teaching community. Graduate student teaching assistants (TAs) also play key roles in delivery and development of teaching, and we now offer a graduate course about geoscience education. Helping TAs gain early-career experience as evidence-based educators is an important aspect of sustainable culture change. Other critical components of success have been highly supportive leadership, as well as enthusiastic, collegial attitudes among our own faculty and across campus. Wieman, Perkins and Gilbert, 2010, refer to EOAS when they say “*Without exception, the more the department as a whole has been involved and seen this as a general departmental priority, the more successful and dramatic have been the improvements in teaching.*”

Where are we now, and what’s next? We have documented successes with course transformations and faculty are spreading new approaches to other courses. We have published in peer-reviewed journals on teaching and learning, facilitated workshops locally, nationally, and internationally, and we have multiple sources of evidence for improved student learning. In the words of UBC’s Dean of Science, Simon Peacock, “*We’ve hit it out of the park with Earth and Ocean Sciences, one of seven departments that are part of the university-funded initiative’... I will declare them to be a success.*” (Mervis, in **Science**, April 19, 2013).

Certainly our progress is encouraging. But, just as scientific research is never “finished”, opportunities for further improvement and research abound, and we are now launching two new projects. The first is a two-year initiative to develop and study student-focused learning activities for use in online, face to face, and blended courses. We will leverage best practices from each teaching mode, and introduce new resources that work in all settings. The second is a three-year initiative to address the significant challenges that faculty and students face in shifting from traditional teaching methods toward strategies and habits informed by research about how people learn (McCrickerd 2012). This project will utilize a co-teaching model so that faculty can develop and transfer new discipline-based educational expertise together – with ongoing support from STLFs. The aim is to strengthen connections within the department in all aspects of undergraduate teaching.

Our cultural norm *has* shifted in the past seven years and teaching and learning in the department has improved. With continued effort, we can work toward more engaging, effective, and evidence-based approaches to science education that are more productive for students and more personally rewarding for faculty. It is an exciting time to be involved.

CWSEI – the Carl Wieman Science Education Initiative, <http://cwsei.ubc.ca/>. Accessed February 22, 2014.

EOS-SEI – Earth & Ocean Sciences Science Education Initiative, <http://eos.ubc.ca/research/cwsei/>. See also research communications, <http://www.eos.ubc.ca/research/cwsei/resources/research/eossei-ResearchList.pdf>. Accessed Feb 22, 2014.

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