



Changing the Teaching Culture in a Large Research Oriented Department

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Carl Wieman Science Education Initiative
at the University of British Columbia



"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.", UBC's Dean of Science, in *Science*, 2013.¹

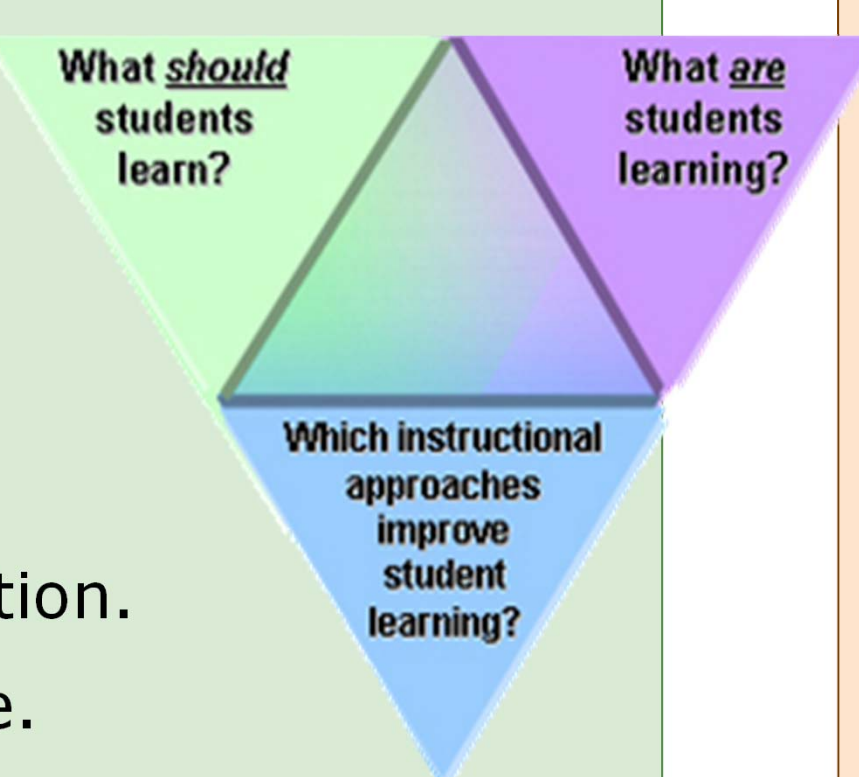
"Without exception, the more the Department as a whole has been involved and seen this as a general Departmental priority, the more successful and dramatic have been the improvements in teaching." in *Change*, 2010.²

Setting and resources

What **conditions** enabled cultural change?

Contributing Factors ...

- Consistent leadership: UBC, Fac. of Sci, CWSEI, Dep't head, Project director
- CWSEI: Funding, oversight, expertise, support, training, research guidance
- Framework: use **Research Based Instructional Strategies** (RBIS)
- Focus: Faculty and teaching assistants first, courses second.
- Emphasis: "Visible thinking", student centric, evidence oriented.
- Engage grad. AND undergraduate students in education development.



CWSEI Model for change:

- Use, Generate, Disseminate research on learning, & avoid re-invention.
- Sustainability: Changes to best practices must persist into the future.
- Time / resources for scholarly practice. Buyout choice: teaching or TA help.
- Community development: Regular STLF meetings, consult for research faculty, use SciEd literature, bring in expert visitors, run events and workshops, publish own research and presentations, collaborate with STLFs and other colleagues ...

Science Teaching and Learning Fellows (STLFs):

- Background: Geosci. PhD or MSc with Sci. Ed. expertise & interests
- Buildup of staff and expertise over time. Then long term consistency of personnel.
- Facilitate communication, consensus building, professional development of RBIS
 - 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
- Consulting model
 - Work with instructors to enhance education, on an as-needed basis.
 - Support experienced TAs to refine needs and develop activities (2-5 per term)
 - STLF supervises TA, and liaises with instructor.
- Conduct & publish: Discipline Based Education Research (DBER)

Accomplishments

What was done? What was produced?

The Aim: to dramatically improve undergraduate education in our Department

- 23 courses underwent 2-3 year "transformations".
- ~15 other courses improved using the consulting model.
- ~35 instructors initially incorporated RBIS in their teaching. ~80% retain RBIS.
- 13 instructors supported for 1 course; 14 for 2 courses; 5 for 3 courses; 3 for 4.
- Two stage exams introduced – figure right →
- Faculty continue improving and transfer RBIS to other courses.
- Increase active learning in classes & using technology.
- Peer-to-peer and group interaction.
- Skills development and critical thinking are emphasized.
- Formative & summative assessments improved.
- Increased opportunities for experts to engage with students.

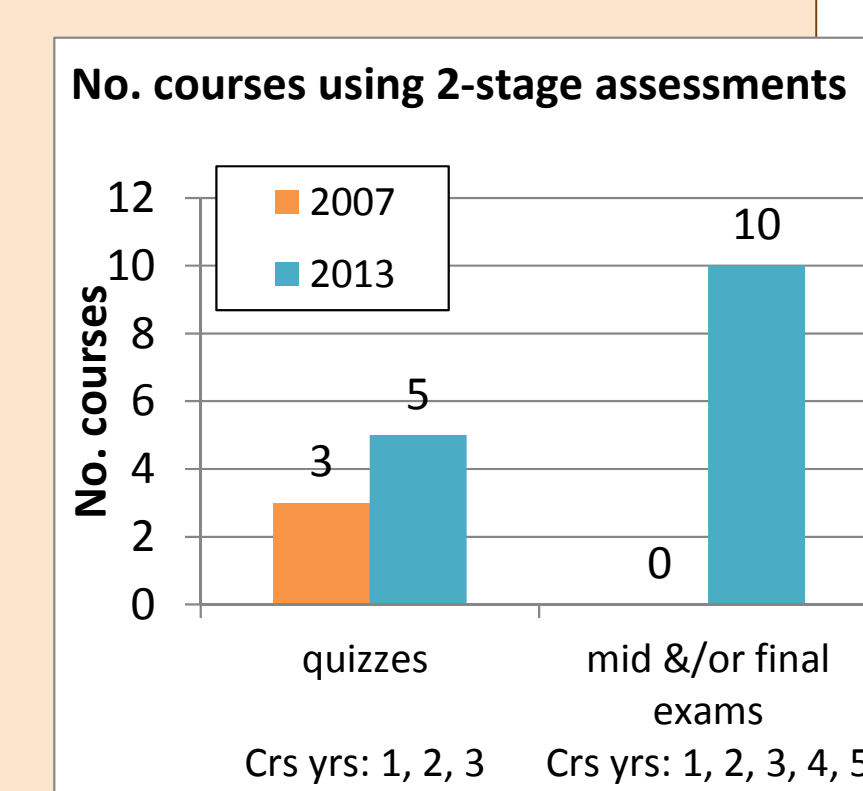
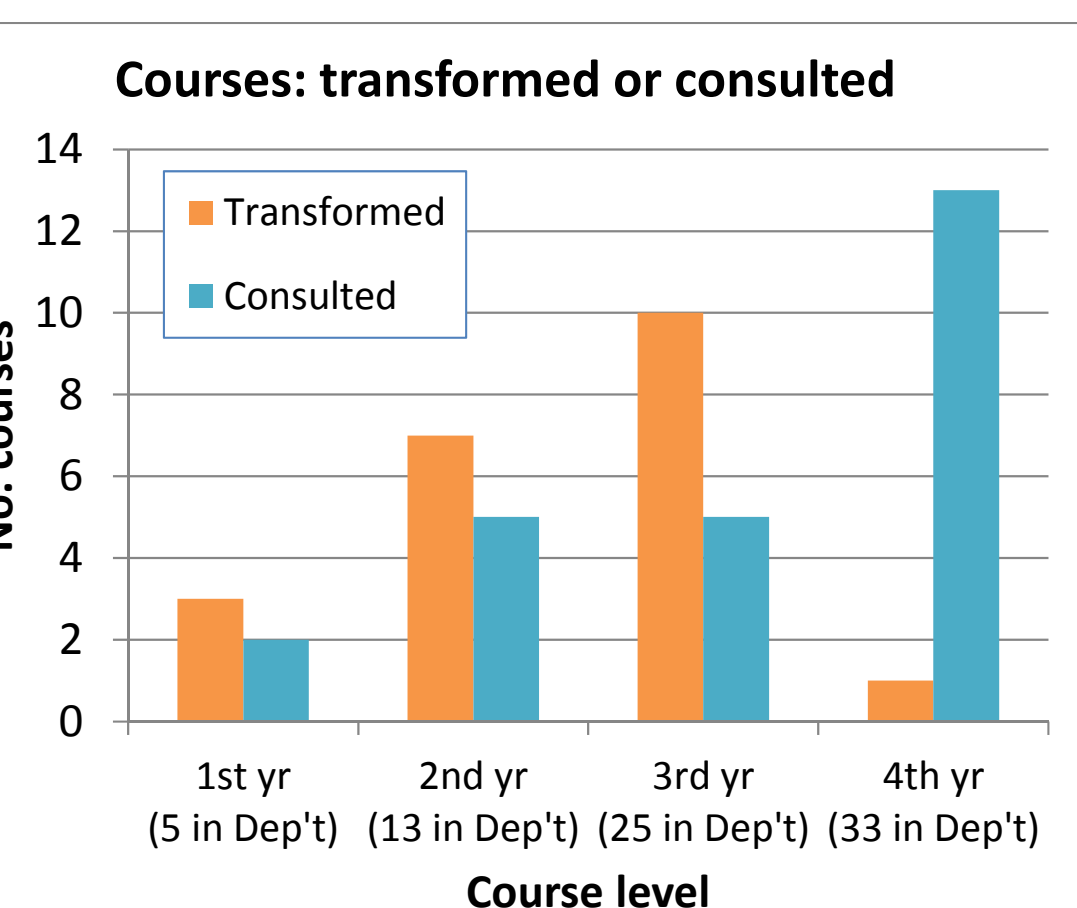


Table showing project flow over 7 years:

	EOS-SEI Long Term Plan, conceived in 2007, adjusted as time progress.														Consulting phase								
	Spr '07	Sum '07	Fall '07	Spr '08	Sum '08	Fall '08	Spr '09	Sum '09	Fall '09	Spr '10	Sum '10	Fall '10	Spr '11	Sum '11	Fall '11	Spr '12	Sum '12	Fall '12	Spr '13	Sum '13	Fall '13	Spr '14	
No. STLFs	1	2	2	3	4	4	4	4	3	3	4	4	3	3	2	2	2	2	1	2	2	2	
Xfrm's in progress		2	3	7	7	10	12	10	13	17	17	16	11	8	9	1							
Grad Course																							
Attitudes (SPSS)																							
Class Obs'ns																							
Work loads																							
Multi Instr																							
Field methods																							
2-Stage tests																							
Video of teaching																							
U.Grad. research							JR			AJ			CW	AJ								JSG	
Publications																							
Others																							



Mineral Deposits:
Two instructors bring closure to a group-based, whole-course synthesis exercise.



Earth and Life Through Time: Instructor helping one of 30 groups who are working on a 50-minute activity. The activity, replacing one lecture, is follow-up to a hands-on lab experience for the 150 3rd and 4th year science students.

Evidence of change

Demonstrable changes in geoscience education & teaching culture

Teaching Practices Survey: 2007 and 2013

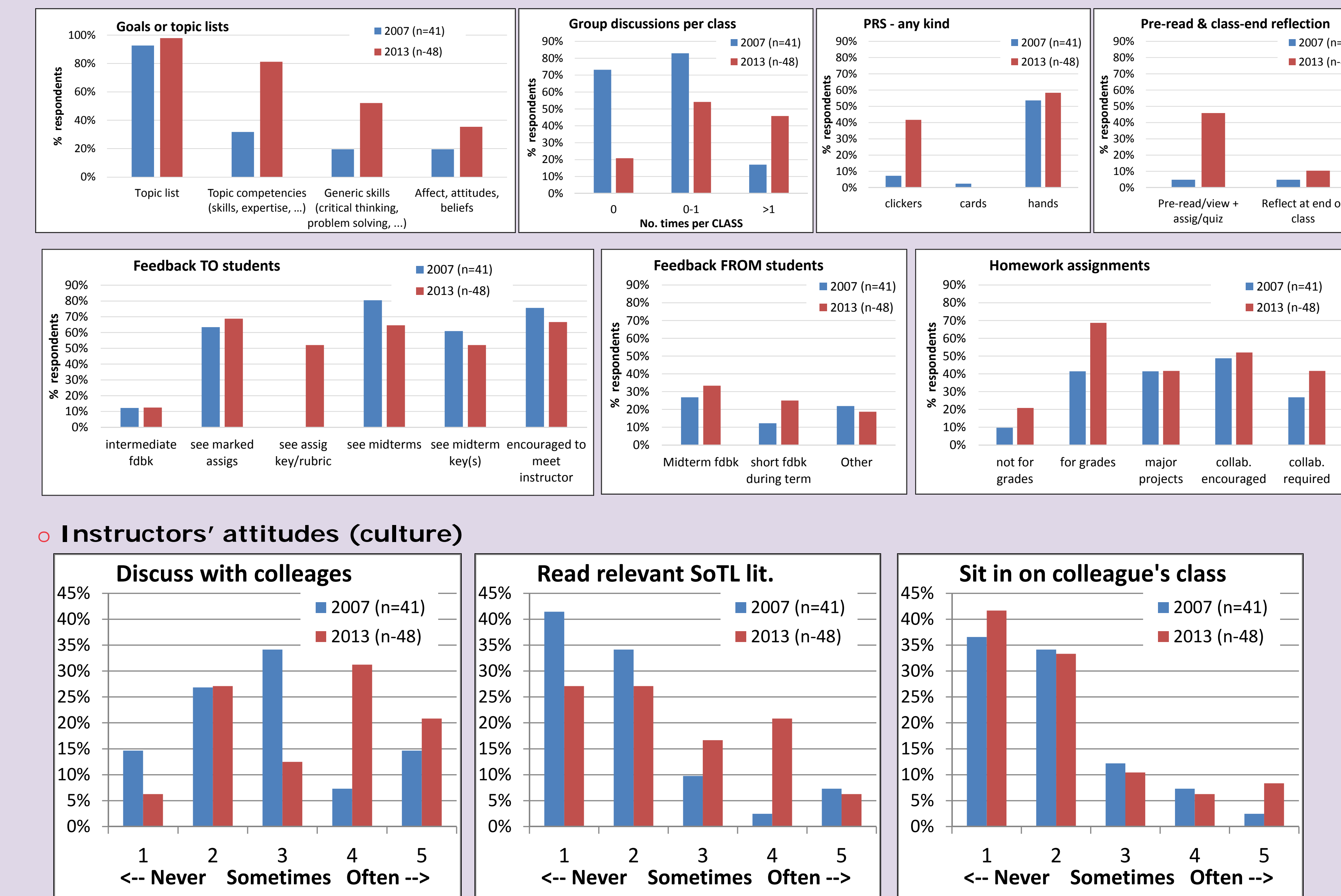
Instructors self-reported for each course they taught:

Raw data:	Responses	Courses	Data presented here:
2007:	58	54	40 courses reported in both years.
2013:	69	62	

Nearly all questions were essentially identical in both years; some additions for 2013.

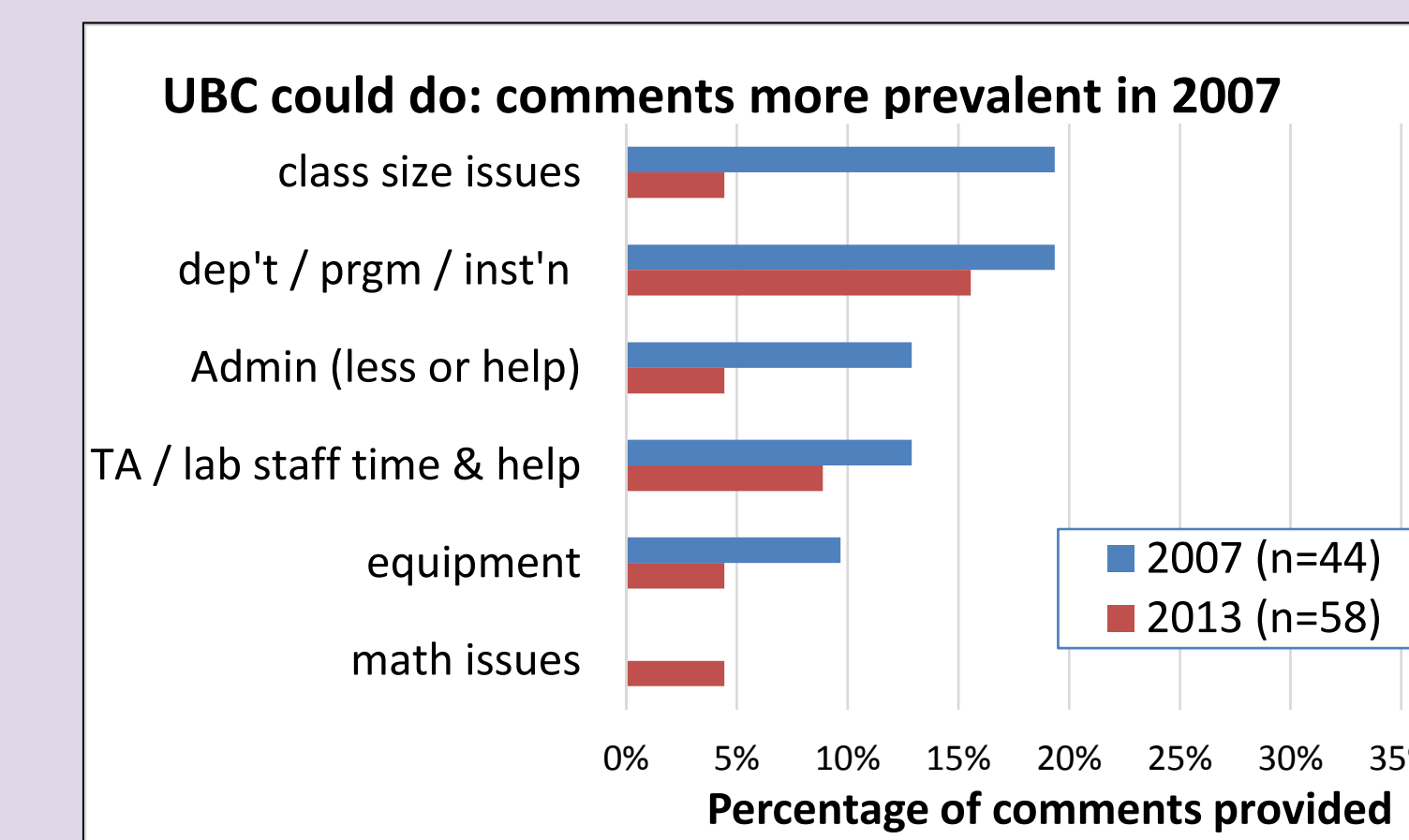
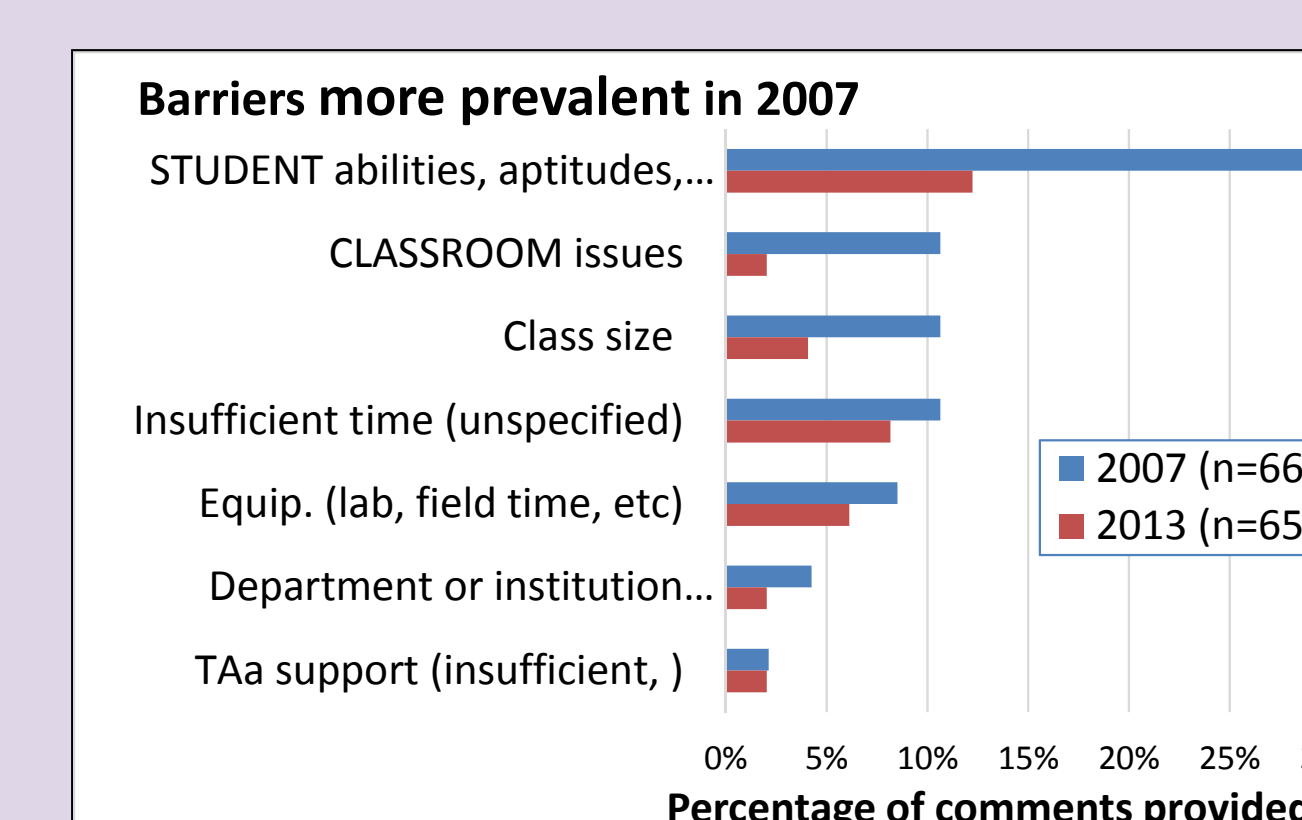
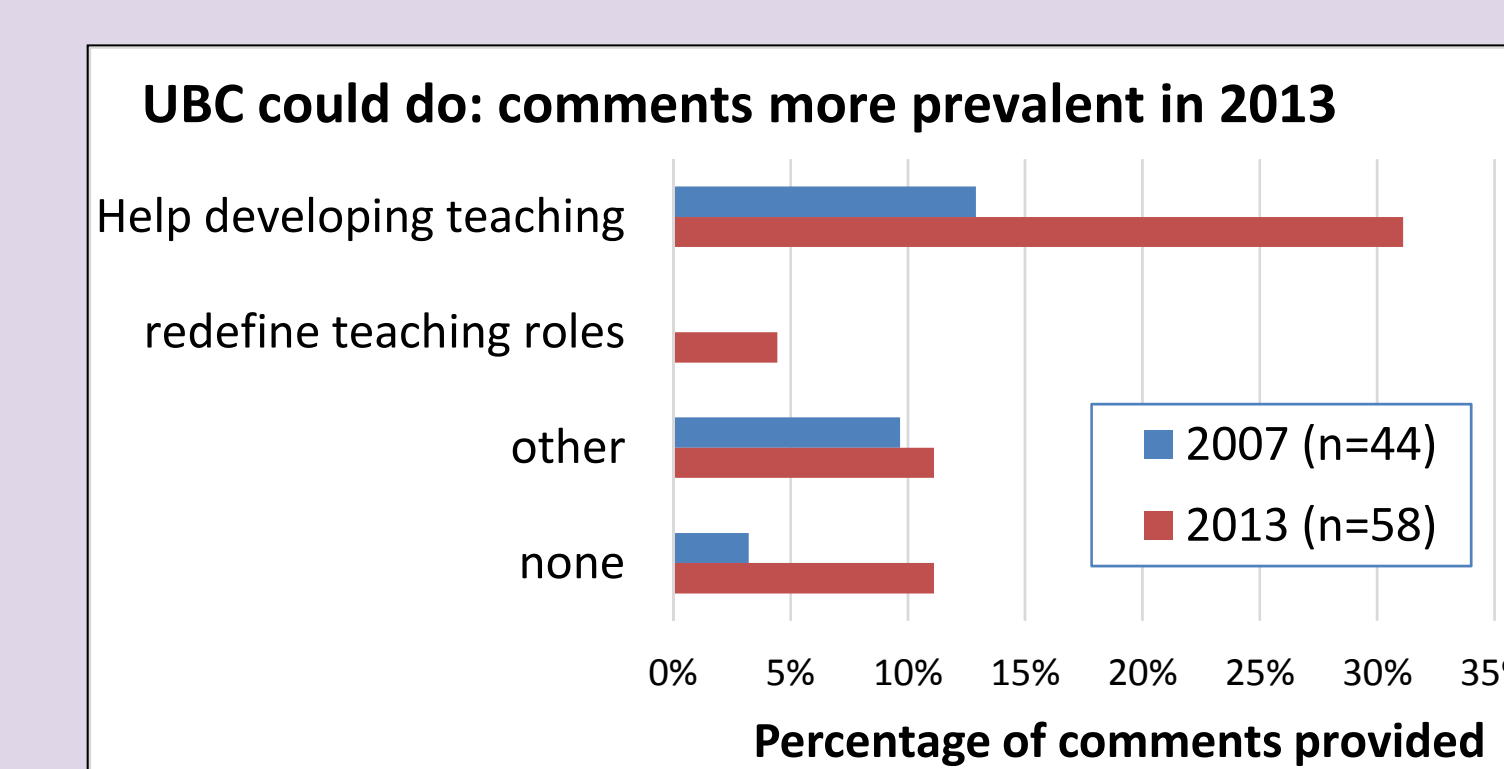
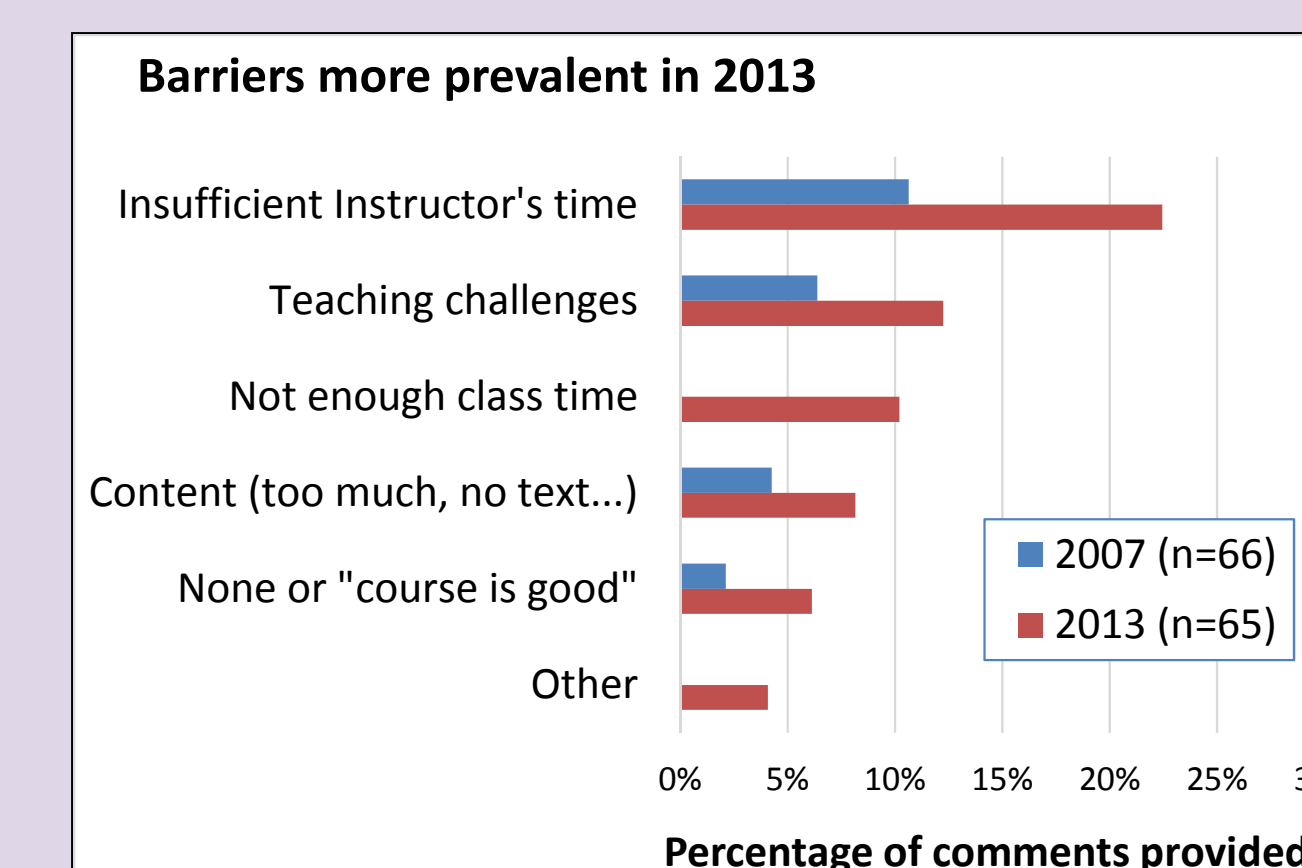
Compare results of Teaching Practices Survey in both 2007 and 2013

Examples of actions



Coded answers to two open-ended questions:

- "What is the biggest BARRIER to achieving more effective student learning in your course?"
- "What CHANGES could be made at UBC to help you teach more effectively?"



Course transformations and project timelines

course	yr	short name	For n students	Core	Elective	Service	Some Highlights	No. terms	EOS-SEI Long Term Plan, conceived in 2007, adjusted as time progress															
									2007	2007	2008	2008	2009	2009	2010	2010	2011	2011	2011	2011	2011	2011		
EOSC114	1	Natural Disasters	1200				multi-instructors, clickers, v.large classes	6																
EOSC111	1	Introduction to Earth Science Processes (1	200	1	1		1-credit lab course (no lecture)	6																
EOSC221	2	Introductory Petrology	80				active classes	5																
EOSC112	1	The Fluid Earth - Atmosphere and Oceans	330				clickers & testing of pre-readings	7																
EOSC220	2	Introductory Mineralogy	80	1			group work, redone labs	9																
EOSC212	2	Topics in Earth & Planetary Sciences	30	1			science thinking focus rather than content	9																
EOSC210	2	Earth Science for Engineers	220	1			clickers, peerwise	9																
EOSC332	3	Tectonic Evolution of North America	50				"pseudo" Just in Time Teaching	8																
EOSC322	3	Metamorphic Petrology	50				active classes	7																
EOSC355	3	The Planets	80				class teams, worksheets, clickers, poster p	7																
EOSC211	2	Computer Methods in Earth, Ocg'y & Atmos	60	1			worksheets, pair-programming, clickers	9																
EOSC372	3	Introductory Oceanography: Circulation an	250				daily online hwk checks on rdgs	9																
EOSC373	3	Introductory Oceanography: Climate and E	150				continuation of 372	5																
EOSC252	2	Geophysical properties of materials	20	1			no longer taught	2																
EOSC472	4	Introduction to Marine Chemistry and Geo	30				scaffolding and peer support for project an	5																
EOSC321	3	Igneous Petrology	50				Poster/present'n is a choice	6																
EOSC331	3	Intro. Mineral Deposits and Exploration Ge	50				team teaching & activities	6																
EOSC326	3	Earth and Life Through Time	150				'Labs' for >150; 50min class activities	6																
EOSC329	3	Groundwater Hydrology	150				Socratic lecturing, clickers (eg derivations)	6																
EOSC222	2	Geological Time	60	1			Inclass activities	3																
EOSC340	3	Global Climate Change	300				interactive lecture, scalable to >250	6																
EOSC350	3	Intro applied geophysics for geoscientists	50	1	1		pseudo TBL	5																
EOSC333	3	Elem&iso geochem	50				active classes	5																

1. Mervis, Jeffrey: "Transformation Is Possible if a University Really Cares", *Science*, 19 April 2013: Vol. 340 no. 6130 pp. 292-296.
 2. Wieman, C., K. Perkins and S. Gilbert, "Transforming Science Education at Large Research Universities: A Case Study in Progress", *Change*, The Magazine for Higher Education, pp. 7-14 (March/April 2010).