



EOS-SEI Year 1 Progress

Earth and Ocean Sciences – Science Education Initiative.

April 28, 2008

EOS Teaching Initiatives Committee – Sara Harris (Chair & Liaison), Mary Lou Bevier, Jim Mortensen, Douw Steyn, Francis Jones (STLF), Brett Gilley (STLF), Ben Kennedy (STLF), Tom-Pierre Frappe, Peter Lelievre, Melissa Grey, Jamil Rhajiak (Phil Hammer, Greg Dipple, Stuart Sutherland)

EOS faculty perspective – Roland Stull

Many others involved, including graduate and undergraduate students



Carl Wieman Science Education Initiative
at the University of British Columbia

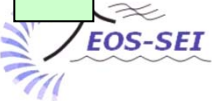
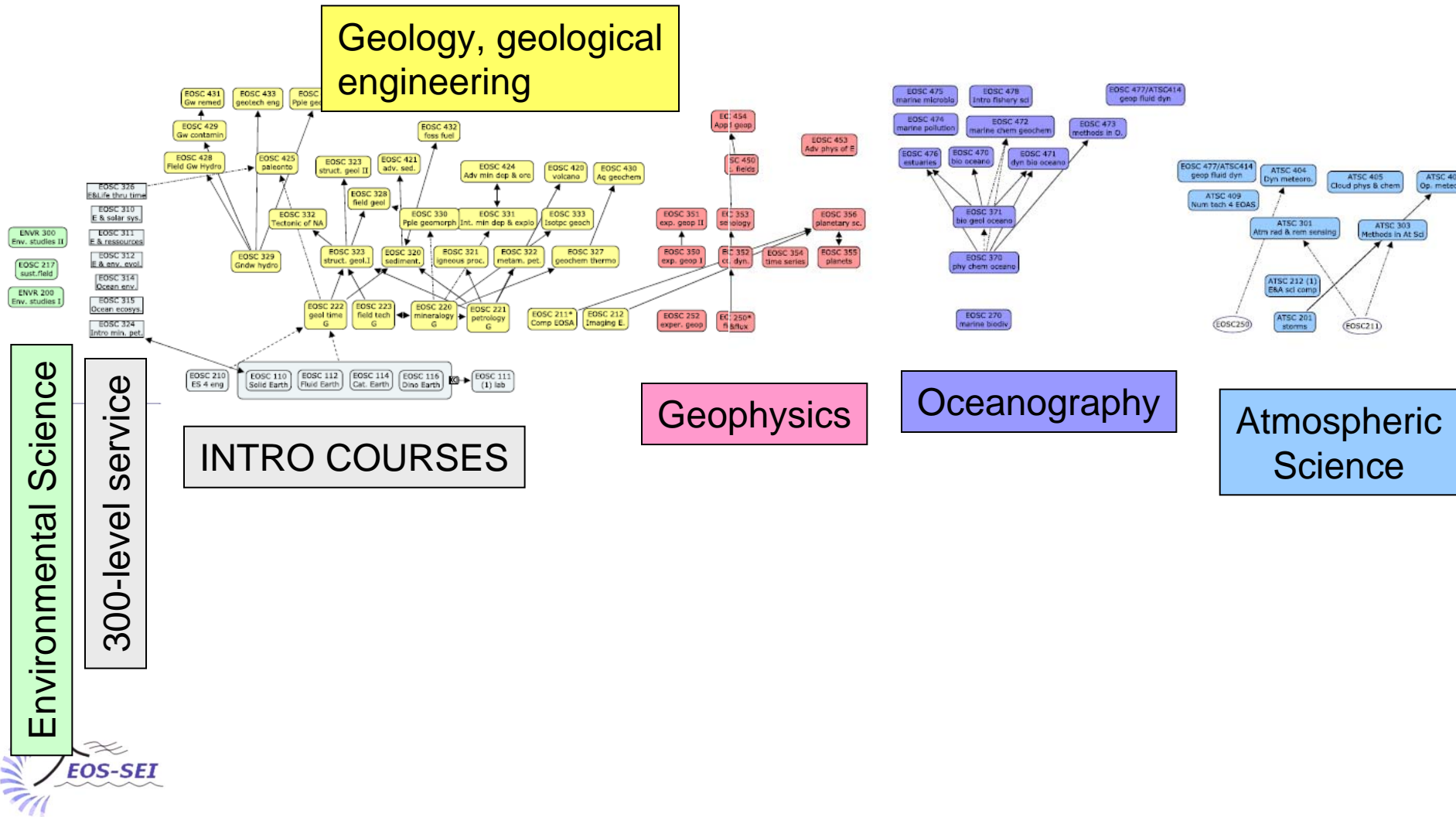


Overview

- The EOS department
- EOS' approach to the CWSEI project
 - Mostly course-based, with...
 - Curriculum considerations and...
 - Overarching components
- Two examples
 - Student Attitudes about Earth Sciences Survey (Ben Kennedy)
 - Perspectives on EOSC 114 Course Transformation (Roland Stull & Francis Jones)



The EOS department – many “streams”



Our approach: Course Transformations

- Course working groups
 - Primary instructors & STLF
 - Faculty members who teach “related” courses (pre-, post-, co-requisites)
 - Graduate and undergraduate students
- Faculty buyouts (for primary instructor)
 - For 3 terms, choice of:
 - ~0.5 course release (NOT the targeted course)
 - 6-hr TA or undergraduate help
- Aiming for high faculty involvement – important for sustainability

EOS-SEI LONG-TERM PLAN

UPDATED DRAFT, STILL FLEXIBLE

P1 = first planning term; P2 = second planning term; T1= first teaching term, etc.

TARGETED COURSES	2007	2008			2009			2010			2011		
	Fall07	Spr08	Sum08	Fall08	Spr09	Sum09	Fall09	Spr10	Sum10	Fall10	Spr11	Sum11	Fall11
STARTED	EOSC 114	P2&T1	P3&T2	P3	T3	T4							
	EOSC 111	P2&T1	P3&T2	P3	T3	T4							
	EOSC 221	P1	T1	P2	P2	T1							
	EOSC 324	MLB											
	ENVR 200	DS&SH											
	EOSC 112		P1	P1	P2&T1	F							
	EOSC 220		P1	P1	T1	F							
	EOSC 212		P1	P1	T1	F							
	EOSC 210		P1	P1	T1	P2	P2	T2	P3	P3	T3		
	EOSC 116		SS										
ENVR 300		DS&KC											
Below this line, course sequence is under discussion. Are you involved in the courses on this list?													
332 (JM)				P1	T1	P2	P2	T2	P3	P3	T3		
322 (GD)				P1	T1	P2	P2	T2	P3	T3			
EOSC 449				MLB									
ENVR 449				KO									
EOSC 211 (RP)					P1	P1	T1	P2	P2	T2	P3	P3	T3
ATSC 201?					P1	P1	T1	P2	P2	T2	P3	P3	T3
EOSC 370 (SA)					P1	P1	T1	P2	P2	T2	P3	P3	T3
EOSC 371 (KO)							P1	T1	P2	P2	T2	P3	P3
EOSC 250? 252? (FH)							P1	T1	P2	P2	T2	P3	P3
EOSC 222 (PS&SS)							P1	T1	P2	P2	T2	P3	P3
EOSC 320?							P1	T1	P2	P2	T2	P3	P3
EOSC 321 (MK)								P1	P1	T1	P2	P2	T2
EOSC 323? 327?								P1	P1	T1	P2	P2	T2
EOSC 329								P1	P1	T1	P2	P2	T2
EOSC 311???								P1	P1	T1	P2	P2	T2
EOSC 270? (MM)									P1	P1	T1	P2	P2

Involves ~60% of EOS faculty as primary instructors, with opportunity for 100% of faculty to be involved in working groups

Courses undergoing transformation w/o specific STLF help

What we've done so far: Courses

- Draft learning goals for at least 13 courses:
 - EOSC 111, EOSC 114, EOSC 221, EOSC 112, EOSC 210, EOSC 212, EOSC 220, EOSC 223, EOSC 310, EOSC 449, EOSC 324, ENVR 200, ENVR 300
- Data collection:
 - Quantitative: pre-post tests of student abilities
 - Qualitative: surveys, focus groups, interviews
- New pedagogy (and plans for new pedagogy)
- Plans for thorough assessment (the key to approaching teaching science based on science)

Plans: Curriculum considerations

- Course-transformation requires defining a course's role in a program/curriculum
 - Departmental structure to define program-level goals
 - Identify links, gaps, overlaps among courses
 - Make recommendations for curriculum changes
 - Make structure sustainable
- CWSEI is an ideal opportunity to examine curricula (human resources to collect and analyze data)
- Starting with service courses:
110, 111, 112, 114, 116, 310, 311, 312, 314, 315
(maybe: 210, 211, 222, 250, 252, 270, 324, atsc201)



Our approach: Overarching components

- Student Attitudes about Earth Science Survey
- TA training
 - Improved professional development for grad students
 - Improved education for undergrads
- Dissemination & discussion of ideas:
 - Seminars, brown bags, tips
- Archiving/Sharing resources

Attitude Surveys in Earth and Ocean Science

Tom- Pierre Frappe and Ben Kennedy

How do you feel towards this statement

“Learning about attitude surveys is useful in my life”

Novice attitude

Expert attitude

Strongly disagree, Disagree, Neutral, Agree, Strongly agree.

Your opinion is different to actually how useful the attitude surveys really are,

However, your opinion about it will affect how much you will learn about it !

Student Attitudes in Earth and Ocean Science

WHY ? Students beliefs and attitudes are a a better predictor of performance in science than the amount of previous science classes.

WHAT ? An online survey for assessing the impact our classes have on students beliefs and attitudes relative to an expert.

HOW? By comparison of answers on identical surveys at the beginning and end of the semester.

WHERE ? Originally developed at Colorado University for Physics and Chemistry. The negative shifts in student attitudes were hugely influential for driving educational reform at Colorado.

NOW- Earth and Ocean Sciences and other departments at UBC fall 07 and spring 08



Survey Development Process, 18 months in

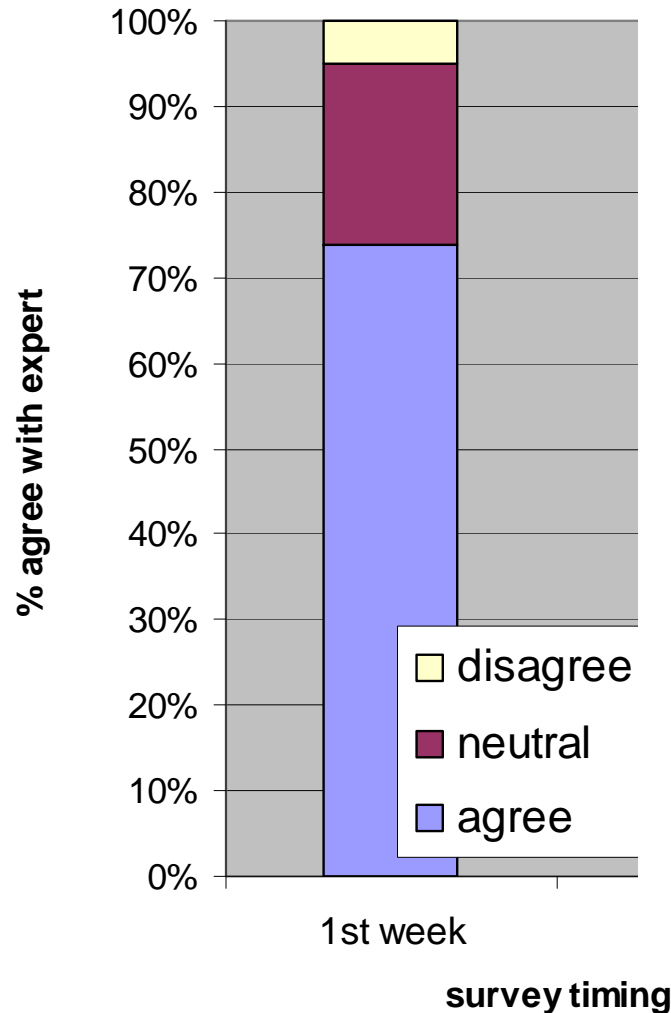
1. Finding out what student scientific beliefs were important to Earth and Ocean Scientists.
2. Adapting the existing physics survey to address these beliefs.
3. Validation- student interviews to assess whether these statements were clear.
4. Running the survey, collecting, and analyzing the results.
5. Validating expert opinion
6. Reworking and improving questions with Colorado who are also working on an Earth Science survey



Results- Spring 08 Response comparisons

Eg From category “Connection to real world”

Things that I see around me in nature often lead me to think about how the Earth works.



800 students

11 classes

37 questions

6 question categories

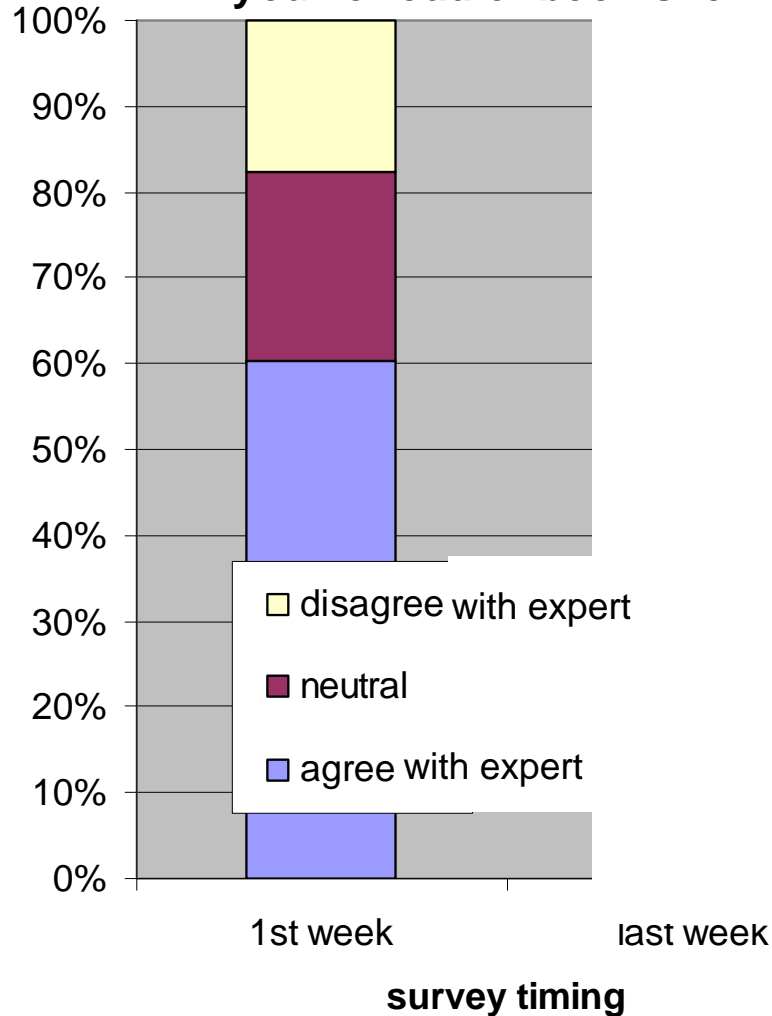
Plotted as “Agreement with expert opinion”

Initially high belief in the real world connection of geology

Results- Spring 08 Response comparisons

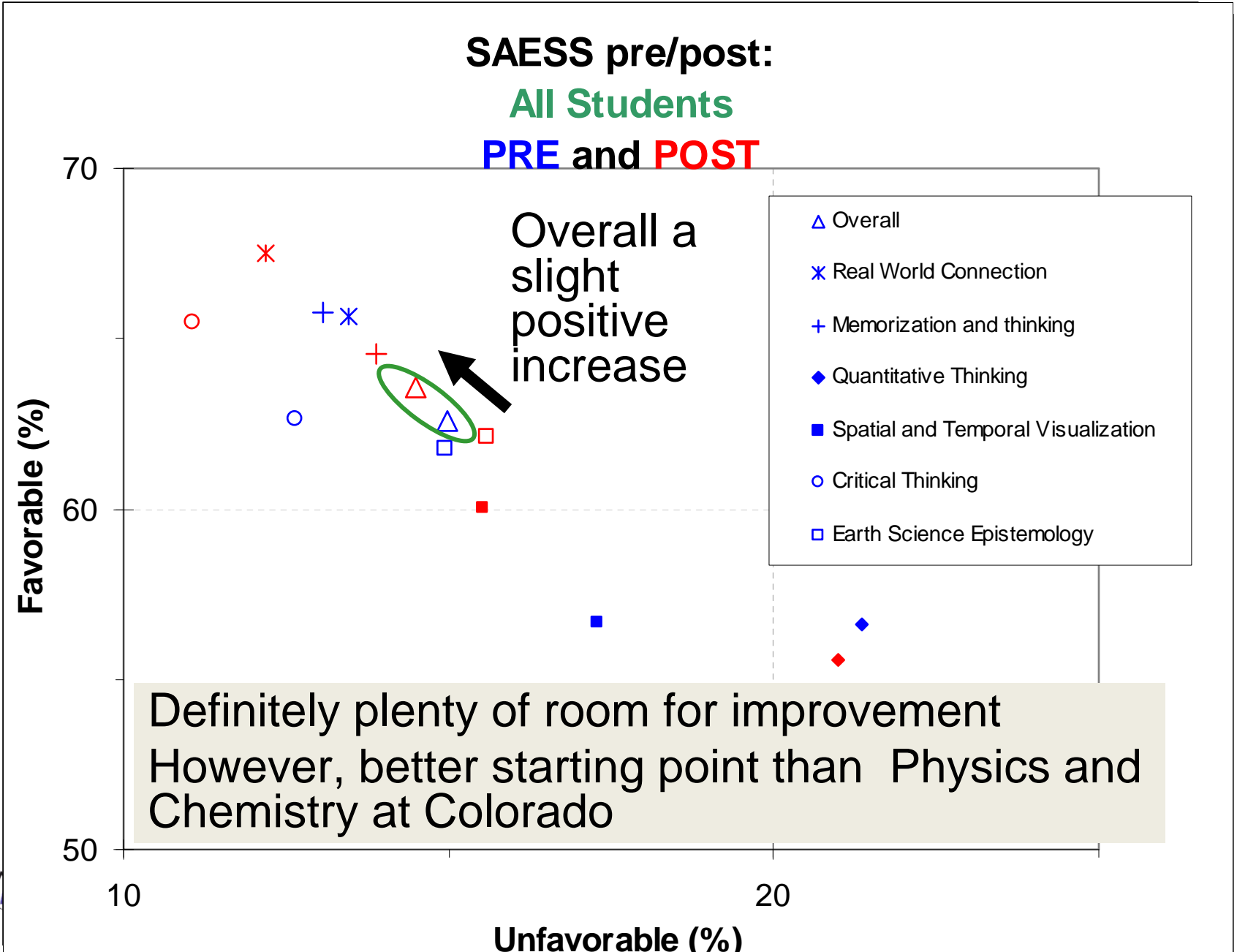
Memorization and thinking

Understanding science basically means being able to recall something you've read or been shown.



After a semester of Earth Science classes, how is this opinion affected ?

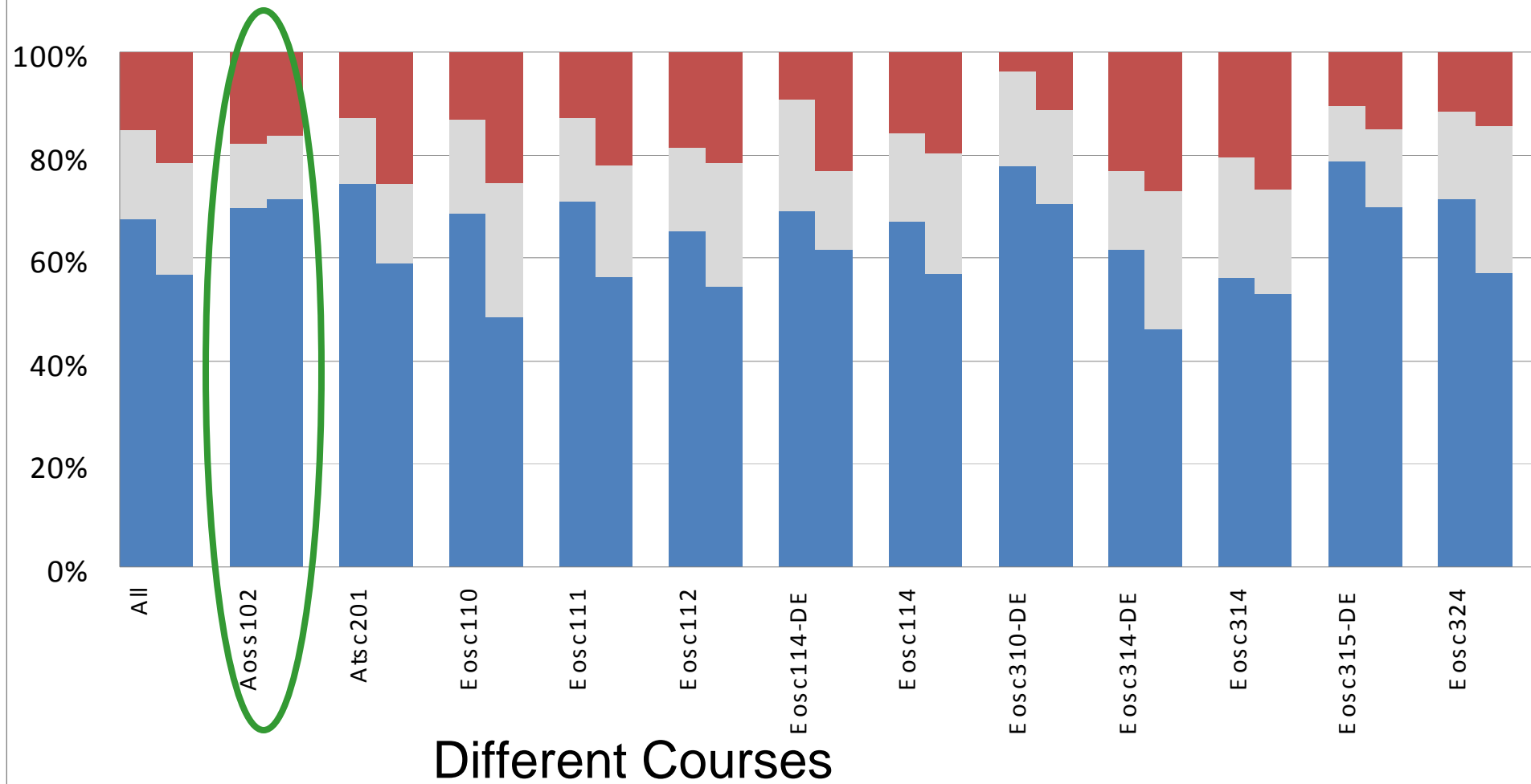
Categories- representing 5-8 questions



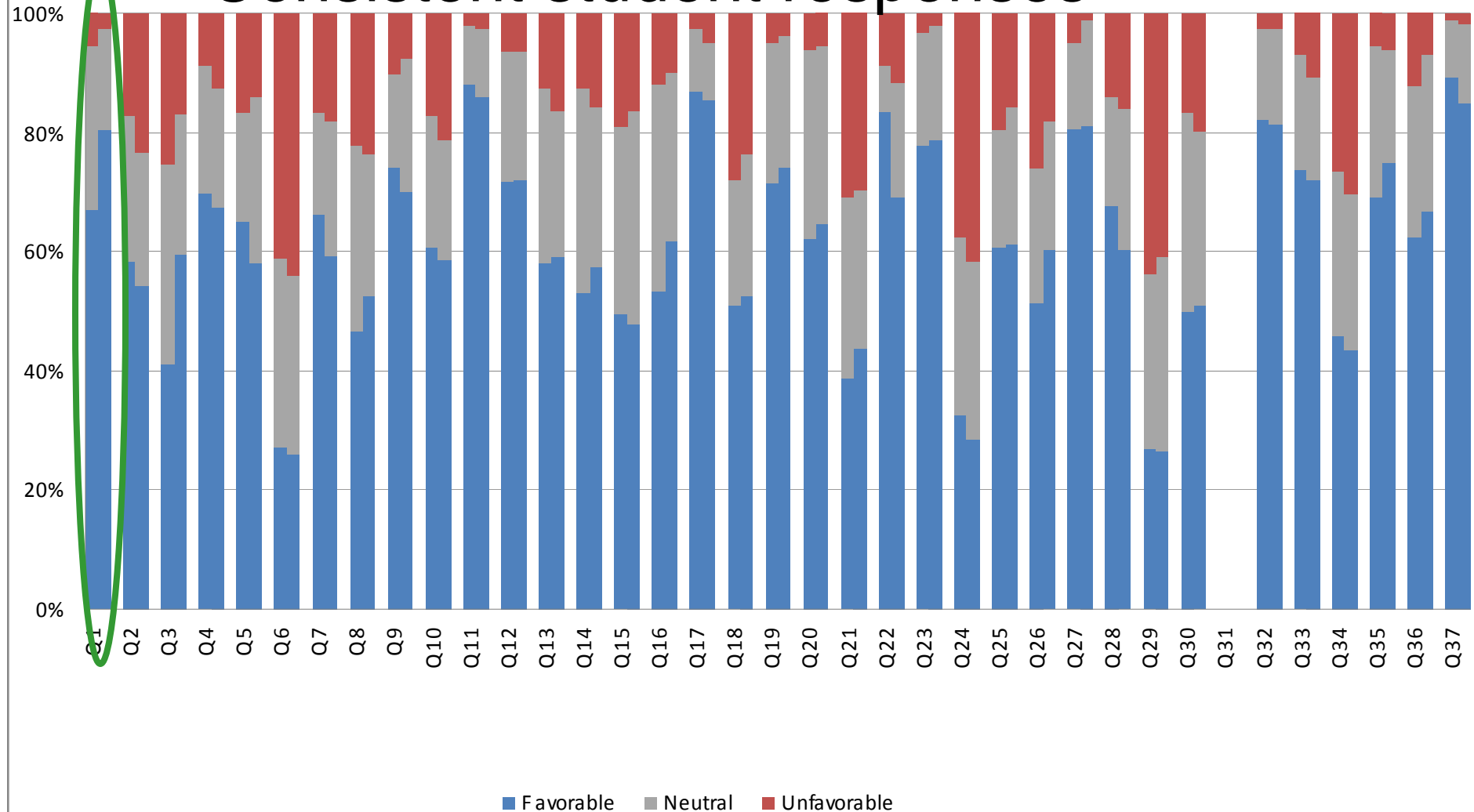
Course comparison- Any course stand out ?

What is this course doing that we are not ?

Understanding science basically means being able to recall something you've read or been shown.



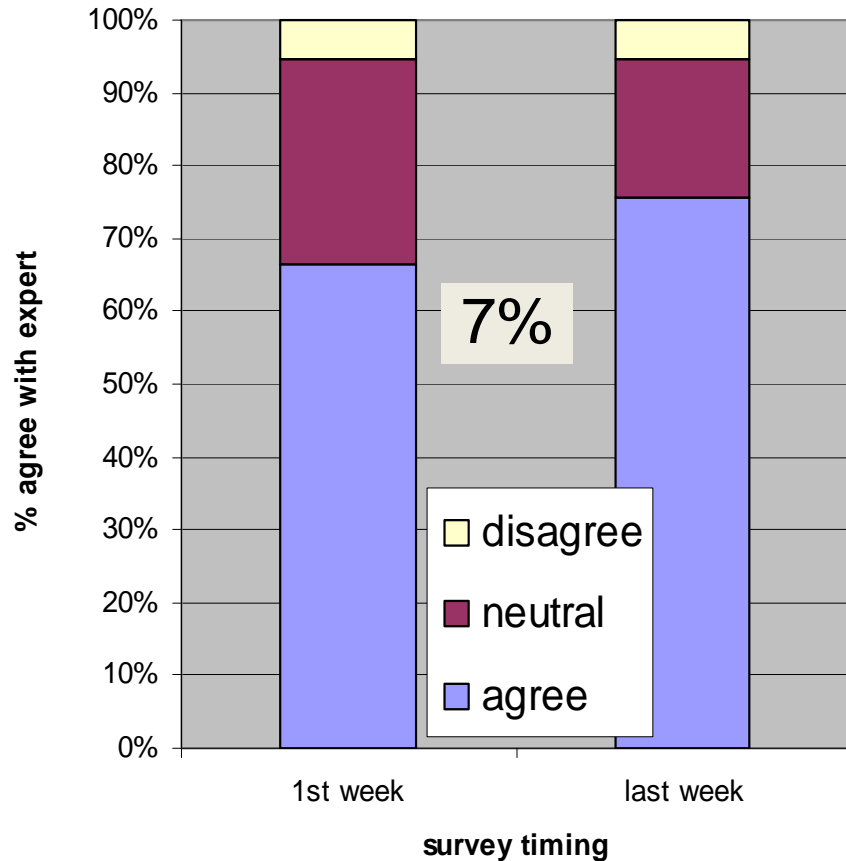
Agreement with expert opinion for each question:
PRE and POST scores side by side spring 08
Year to year comparison in a class
Consistent student responses



Year to year comparison EOSC 114

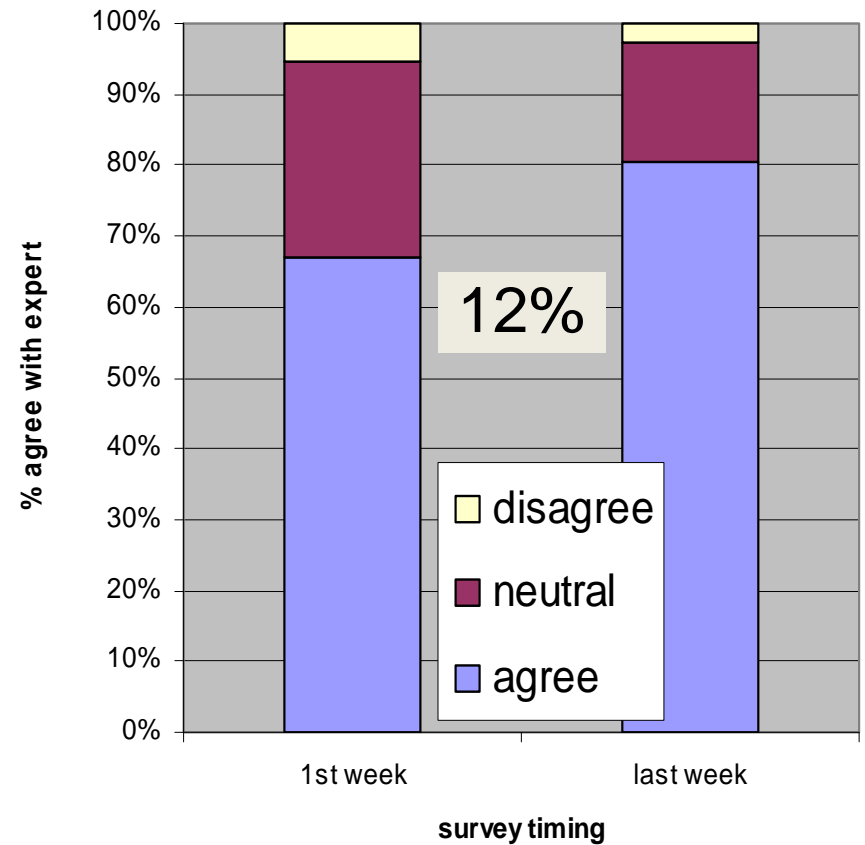
Fall 2007

Things that I see around me in nature often lead me to think about how the Earth works.



Spring 2008

Things that I see around me in nature often lead me to think about how the Earth works.



Attitude Survey Summary

- Student attitudes and beliefs towards EOS showed a 0-2 % positive shift which differs from initial published results from Physics and Chemistry at Colorado that showed a 5-10 % negative shift.
- We should be aiming for large positive shifts in student attitudes in all categories
- The survey highlighted particular attitudes that can be concentrated upon for course improvement.
- The survey highlights courses that are positively effective and negatively effective in changing student attitudes.
- The survey highlights positive and negative changes in courses over time.

How do you feel towards this statement now ?

“Learning about Attitude surveys is useful in my life”

Strongly disagree, Disagree, Neutral, Agree, Strongly agree.

Faculty – STLF interactions

Handout: General model for STLF-Faculty member interactions (C. Wieman)

- Who
- Learning goals
- Assessments
- Resources
- Sustainability
- General timing

Interaction between Faculty, Department, Students, TAs, C. Wieman, other STLFs ...

These are highly case-specific.

But guidelines are an excellent starting point.

Faculty – STLF interactions

At EOS:

- Teaching faculty
 - Buyouts ... provides (some of the) necessary time.
 - Actions: initial goals, assessments, activities, content ...
- STLFs:
 - Advice, edits, recommendations based upon ...
data acquisition (observations, interviews, etc. etc.) &
analysis
 - Implement, collection, analysis of evaluation of efforts.
 - Contribute (growing) knowledge about learning & pedagogy.



EOS-SEI Year 1 Progress in EOSC114

Earth and Ocean Sciences – Science Education Initiative.

April 28, 2008



Carl Wieman Science Education Initiative
at the University of British Columbia



Outline

- EOSC114
- Course transformation context
- Process
 - Examples of effort to date
- Aims for the September 2008 fall term
- Faculty experiences during the process

EOSC114:

The Catastrophic Earth - Natural Disasters

- First offered Fall '01
- Maximum No. students
- Minimum cost of delivery
- Intro. to Earth, Ocean, Atmospheric Science
- Highlight EOS Faculty and research areas

- Fall '06: Begin increasing activity in lectures (clickers).



EOSC114: Course transformation context

- Very popular
 - 2005W: 785
 - 2006W: 826 + 211 Distance Ed
 - 2007W: 809 + 320 Distance Ed
- Efficient & Effective
 - Lecture style: 6 modules; 4-5 instructors;
 - Assessments: 2 midterms + final exam, all multiple choice.
 - Drop-in centre with graduate student TAs.



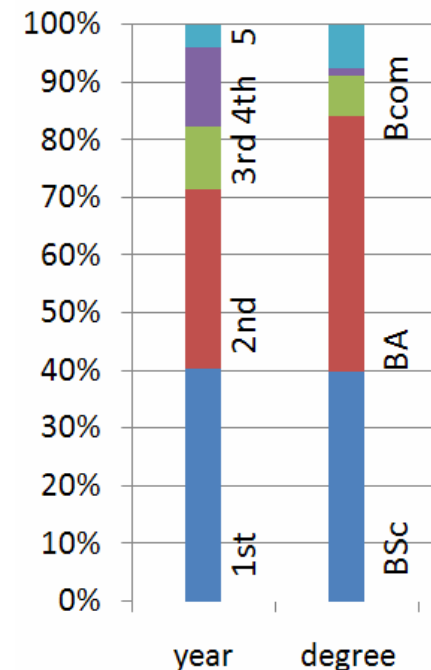
Poster Presentation

Balancing the diverse goals of a large team-taught first year science course
F. Jones, R. Stull & J. Caulkins

23rd Annual Conference of the SoTL in Higher Education, UBC, June 2003.

EOSC114: Course transformation context

- What needs modifying?
 - Learning & assessments are very “passive”.
 - Continuity and consistency are challenging with multiple instructors.
 - Needs, prior knowledge, and abilities of different student groups: a trade-off.
 - B.Sc.
 - B.A.
 - EOS degree programs
 - Data from Spring 2008 EOT.



Course transformation process for eos114

1. Learning about the course and student's needs
2. Goals (course and module)
3. Assessments of learning, keyed to goals
4. Active learning and feedback, including:
class time, homework, resources.
5. Measuring effectiveness
6. Sustainability of initiatives

1. Learning about the course & student's needs

- Observations of class in action
 - Example next slide
- Interviews with instructors (not “discussions”)
 - “What challenges do you perceive with this course?”
- Interviews / focus groups with students
 - Example next slide
- Past assessments
 - Assignments
 - Class activities (clickers, others ...)
 - Tests – aligned with apparent goals?

Example of observations

- Simple coding helps.
- Focus on specific issues chosen by instructor.
- Example later if interested.

SH. 2008-03-28

- 09:03:35 after my request for help and the instructor evaluations announcement.
- doing rogue waves.
- NB - handed out about 10 cards by wandering around the class.
- sitting in front helps see up the class. A good change from sitting in the back.
- Again, note how settling doesn't finish until 09:06:11 or later. Implications is keep content 'trivial' for that period. Include this in large lecture guidelines.
- View from the front: surprisingly not full - maybe less than half. The chattering and most people are in the upper half.
- TODO - IDEA maybe we should do all lecturing from up on the mid-level. This means we must supply remote slide advancers.
- Missed an opportunity for humor when mentioning wreck beach and "geology"
- Too much time on groins? maybe not since the handsup pole was 50-50 split. Evidence for an extra clicker question.
- clicker - no talk first, everyone in front is looking up and thinking. Good split of answers. Pair share for the next part produced a better result.
- Current events - the Longisland case. 09:25:17
- The wave over wall clip caused some chatter - should we make use of that? Should each video always cause some discussion? Inquiry based thinking?
- Clicker survey about climate change. I wonder if another option (other than A) could be "Humans are solely responsible for it" ??
- The antarctic & greenland plot with it's graph is very complicated! Jargon = eustatic.
- So is the next slide. It's an "odd" graph. Not sure I understand the two bars ...
- Concept of prediction and envelopes is "important"? test it? complex graphs etc. What was actually learned by students? what did they really think about it all?
- Was the connection between global climate and shorelines made explicit? Not sure ...
- Clicker - I did notice that some those who were asleep woke up for the questions. Defense of the answers doesn't seem to work (again). However the range of options was OK. I guess saying "any thoughts about answer A" doesn't work so well because the thought has already been done. I do like all right except one option.
- 09:47:23 - still struggling to finish. The final map was rushed.
- Last clicker survey at 09:47:58. People are definitely packing up. But it retain themk better than otherwise.
- IDEA So yes, put a no-stress question in at the end. We do have to manipulate the class time to squeeze out the first and last 5 minutes. Also we do need to make these steps consistent for all instructors and so students know what to expect.

Example of interviews / focus groups

- Regarding EOS service course curriculum:
 - WorkStudy: 2 focus groups (6 stds) & 10 interviews.
 - Strive for consistent data without “discussion”.

QUESTIONS				Notes
	Positive	Neutral	Negative	
1				
2				

- EG: When asking about what students did not enjoy:

...and with me I thought I could just do the readings because the lectures were so similar to them and there wasn't much new stuff in class that I couldn't have just studied on my own at home.

2. Goals (course and module)

- For instructors: learning goals workshop
- Course level
 - Initial attempts
 - Iteration
- Module level
 - Range of Bloom's Levels
 - All cognitive domains
(cognition, metacognition, psychomotor, affect)
- Lesson level goals are more “moveable”
- Connection with curriculum

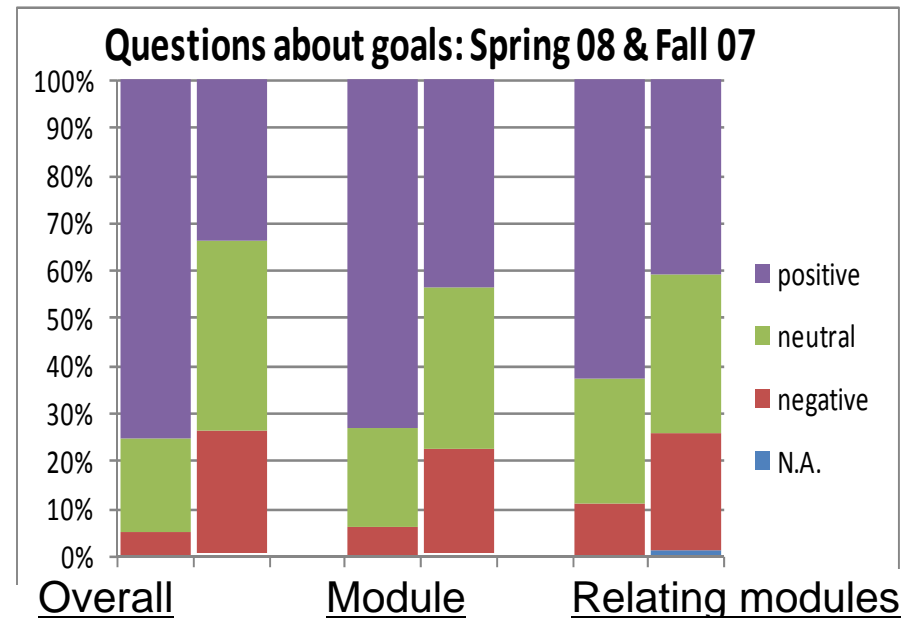
Course & module level goals

- EOT survey shows improvement in recognition of goals:

Three questions: Agree or disagree?

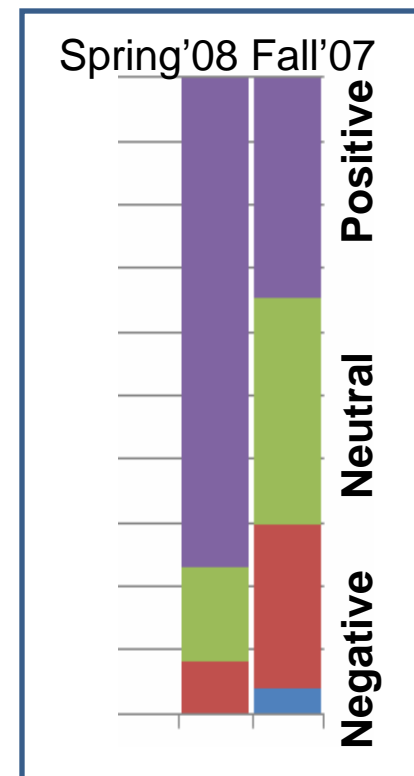
- a. Overall learning goals were clearly expressed for the course.
- b. Ditto ... for each module.
- c. Relationship between modules was clear.

- » Spring 08 left
- » Fall 07 right.



3. Assessments of learning

- Closely connected with goals
- Integral part of “active learning”.
 - Informs students of progress towards goals
 - Instructors see areas needing support.
- Tests / Exams
 - No surprises for students
 - Range of cognitive domains and Bloom’s levels that match those of goals.
 - Improved from F’07 to S’08 (EOT):
 - *“The grading system is adequate.”*
(two midterms and a final exam)
 - BUT ... student “likes” & “best practice” are not always the same ...?



Course transformation process for eos114

1. Learning about the course and student's needs
2. Goals (course and module)
3. Assessments of learning, keyed to goals
4. Active learning and feedback, including:
Class time, Homework, Resources.
5. Measuring effectiveness
6. Sustainability of initiatives

4. Active learning: Class time

- When instructor can be useful.

Quote from EOT comments:

What are things you really like about this course?

“PRS and how 2 instructors would go over confusing aspects at the begging of each of the classes.”

and

“the enthusiasm of the teachers and the way they took feedback and responded the next class.”

Active learning 1: Class time

- When instructor can be useful
 - Clickers: many uses, but non-trivial to do well.
 - Alternative activities:
 - 5-min projects
 - Questions on paper
 - Many other ideas in the literature
 - JiTT: Just in time teaching (www.teachingdvd.com)
 - (Video examples of pedagogy are **very** helpful.)
 - “Disaster scenario” day.
 - Observations show this was highly effective.

Active learning 2: Homework

- Readings, Pretests, Bulletin board activity, etc.
 - Assignments to increase “depth” and provide ownership of content.
- Requires
 - Management
 - Coupling with class work (JiTT)
 - Time (e.g. better use of TAs)

Active learning 3: Resources

- Clickers
- WebCT
- Questions bank or database (*SkyLight grant*)
- Text book. Was poorly integrated into the course.
 - EOT: 70% disliked it or were neutral
 - EOT: 90% LIKED or neutral re. notes on web
- NEW: custom text
 - All instructors agreed – R. Stull will implement ASAP.

Course transformation process for eos114

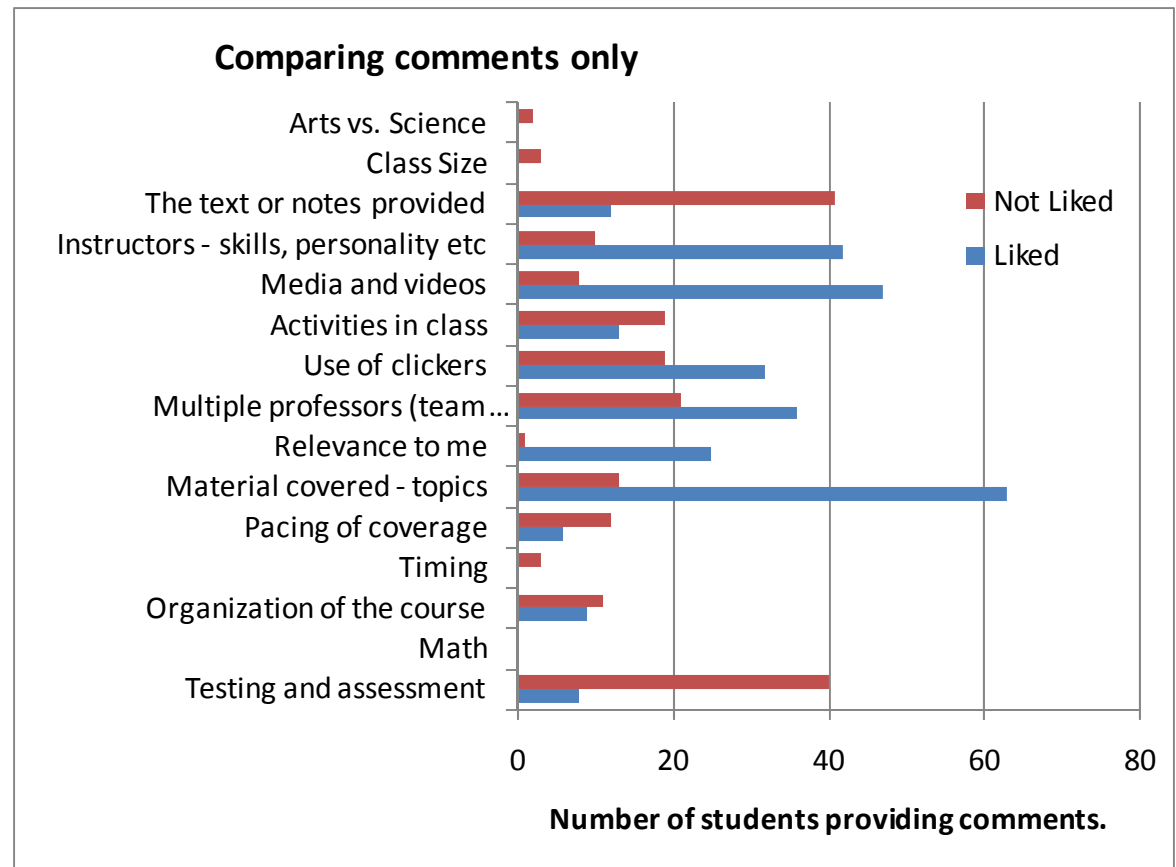
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5. Measuring effectiveness of initiatives

- Comparing the current to the “optimal” course
- Analyzing assessments
 - Comparing to previous terms
 - Specific questions.
 - “Level” or complexity of questions that are being asked.
 - Analysis of how “maturity” changes during term
 - Requires product from students, and analysis time
 - Specific pre-post questioning strategies.
- Carefully prepared EOT surveys
 - Use precedent about surveying (eg SALG instrument)
 - Evolve towards long term consistency
 - Example: [Spring 2008 summary pdf.](#)

5. Measuring effectiveness of initiatives

- Example of EOT comments (203 of 348 students)
- Look for what was “liked” and what was “not liked”



6. Sustainability of initiatives

- Faculty become more *expert* about learning and pedagogy
- Procedures & tools
 - Eg. **Questions Database** (*SkyLight grant*)
 - Eg. Streamlined administrative procedures (Vista??)
- Archiving and transfer
 - CWSEI archiving project: Content & Pedagogy

Aims for the September 2008 fall term

In progress – priority list by 1st quarter of May

- All instructors need to be involved. Hence time buy-outs
- Recommendations: priorities based upon S.W.O.T. summary
- SWOT to be built by mid-May based upon
 - all class observations,
 - Interviews & Focus groups (WorkStudy assistant)
 - Assessments – clickers and exams
 - End Of Term surveys from Fall'07 and Spring'08.

Aims for the September 2008 fall term

Opportunities for research (very tentative)

- Evaluate initiatives related to JiTT
(use of *Vista*, BB use, QuestionDB, transfer to new instructors, etc)
- Study questions that students pose.
- Observe improvements in ...xxx... from early to late in the course.
- Compare sophistication of tests / activities / questioning to previous yrs.

Faculty perspective

- Roland Stull

People involved so far... at a minimum...

TIC & 1 ^o instructors	Sara Harris, Mary Lou Bevier, Jim Mortensen, Greg Dipple, Douw Steyn, Phil Hammer, Tom-Pierre Frappe, Erik Eberhardt, Francis Jones, Brett Gilley, Ben Kennedy, Mark Jellinek, Roland Stull, Michael Bostock, Roger Francois, Stuart Sutherland, Stuart Mills, Lee Groat, Uli Mayer, Maya Kopylova
Working Groups & Other	William Hsieh, May Ver, Kurt Grimm, Mark Bustin, James Scoates, Ken Hickey, Lori Kennedy, Dominique Weis, Susan Allen, Maite Maldonado, Kristin Orians, Kelly Russell, Philippe Tortell, Paul Smith, Mati Raudsepp
Grad students	Peter Lelievre, Melissa Gray, Jackie Dohaney, Leigh Gurney, David Cassis, Brendan Smithyman, Mark Halverson, Chris Leslie, Kirsten Hodge, Alyssa Shiel, Mika McKinnon, Danny Bay, Holly Peterson
Under- grads	Jamil Rhajiak, KC Smith, Ryan Harvey, Jonathan Elmer, 111 students, 221 students (past & present), also hiring now for summer Skylight/EOS-SEI project

Plans for the future

- Continue work on course transformations
- Continue work on Attitudinal Survey
- Continue developing TA training program
- Serious effort toward examining curricula
- Work on archiving and effective transfer of materials to new instructors
- Expand seminars/discussions – visibility, maximize departmental involvement

...a work in progress...

