

Comparing Student, Instructor & Observer Data to Assess a 7-Year Department-wide Education Initiative

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Carl Wieman Science Education Initiative at the University of British Columbia



Abstract:

Assessing a 7-year initiative aimed at enhancing evidence-oriented pedagogy, relevance, connectedness and class, lab or external experiences across a highly interdisciplinary department is complex. Useful perspectives include measures of learning, students' experiences, instructors' practices, and third party observations. We present preliminary comparisons of data gathered from all courses in one large, interdisciplinary science department, including students' perceived learning experiences, instructors' teaching practices reported before and after the initiative, and third party observations of classes. **This example emphasizing feedback about "active classes" illustrates how using three different perspectives yields greater confidence when evaluating education innovations than using only one data type.**

Background, context and the data sets

The EOS-SEI, and data sets for project evaluation

EOS-SEI Earth & Ocean Sciences – Science Education Initiative⁵

- 7 years support from the Carl Wieman Science Education Initiative (CWSEI⁶);
 - 22 courses "transformed"; ~27 "consulted";
 - ~78% faculty participation rate; 6 STLFs*, 2 for 7 years;
 - 25 grad. / 10 u-grad. contributors; 4 u-graduate theses;
 - 9 publications, ~40 presentations, many workshops.
- *STLFs are Science Teaching and Learning Fellows (education support). See ref. 5.

Stakeholders

Who	Data (Measures of impact)
Students	- Measures of learning - SLES; Perceptions of learning experiences
Instructors	- TPI; teaching practices inventory ² - Evaluations, interviews and focus groups
Teaching assist's	- Pedagogic expertise - Contributions to development
Dep't / Faculty / UBC	- Changes in programs & management
SoTL and H.Q.P. (eg. STLFs)	- Research project output - Contributions to DBER and development

Data sets

Data	When	Size
Students	Fall 2013, Spring 2014	Response rates: ~80% in classes < 140 ~20% in classes > 200
SLES ¹	~2600 students 57 / 63 EOAS courses	
Including Workloads & Enthusiasm	2009 - 2014	- Various prior to SLES - Same as SLES in 2013/14
Instructors	2006/7 & 2012/13	
TPI ²	40 courses in both years	Instructors 47 41 Courses 54 62
Observations	Spring/Fall 2012	22 classes (pre-COPUS)
COPUS ³	Fall 2013	30 classes; 24 instructors
	Spring 2014	29 classes; 27 instructors

Number courses with SLES data	Class size	#
200-400	9	
100-200	8	
50-100	10	
15-50	21	
0-15	8	

Number courses with SLES data	Sample size	#
75-100%	22	
50-75%	18	
25-50%	9	
15-25%	6	
0-15%	2	

Summary and directions

- All three perspectives independently suggest increased use and student appreciation of active classroom strategies.
- Student perceptions identify what THEY see as motivational and worthy of effort.
- Instructor's perceptions of their teaching practices indicate increased use of research-based teaching practices after 6 years of the initiative.
- Classroom observations give objective insight about student & instructor actions during classes, and enable opportunities for instructors to engage with colleagues & support staff to communicate about teaching.
- These rich datasets also yield a wealth of other aggregate and specific information.
- NEXT – complete data sets need mining for insight about individual course needs and those of the department, curricula and students.
- NEXT – these data sets provide rich baseline information to help with evaluation of ongoing and future innovations.
- NEXT – work with instructors on specific improvements identified by lower helpfulness scores (eg: clicker discussions, feedback on homework, and others).

References

- SLES: Student Learning Experiences Survey - http://eos.ubc.ca/research/cwsei/resources/studentssurvey-v9.pdf
- TPI: Teaching Practices Inventory - http://www.cwsei.ubc.ca/resources/TeachingPracticesInventory.htm
- Smith, M. K., F. H. M. Jones, S. L. Gilbert and C. E. Wieman, "The Classroom Observation Protocol for Undergraduate STEM (COPUS): a New Instrument to Characterize University STEM Classroom Practices", CBE Life Sci Educ vol. 12 no. 4 618-627. http://www.cwsei.ubc.ca/resources/COPUS.htm
- Seymour, Elaine, Douglas J. Wise, A. Hunter, and Susan M. Duffinrud, "Creating a better mousetrap: On-line student assessment of their learning gains." In National Meeting of the American Chemical Society, 2000.
- C. Wieman, K. Perkins and S. Gilbert, "Transforming Science Education at Large Research Universities: A Case Study in Progress", Change, pp. 7-14 (March/April 2010)

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Three data sets ; three complementary perspectives, highlighting results on active classroom strategies.

What students perceive about learning experiences (SLES¹) ~~~ How instructors say they teach (TPI²) ~~~ What observers see happening in classrooms (COPUS³)

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STUDENT PERSPECTIVES: Student Learning Experiences Survey = SLES¹

Perceptions relate to motivation ... hence ... "Which teaching/learning strategies will students respond to productively?"

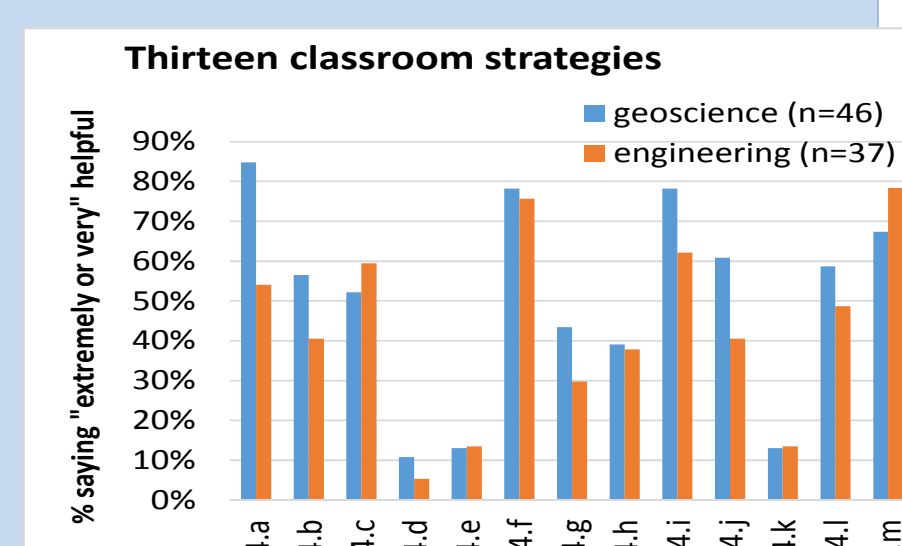
Data – survey asks about 4 types of experiences:

1. Info. provided (9 qns)
 2. classroom strategies (13 qns)
 3. homework & feedback (18 qns)
 4. workloads/enthusiasm
- Multiple choice questions use a 5-point Likert scale based loosely on Seymore et al. 2000⁴.
 - a) extremely helpful
 - b) very helpful
 - c) moderately helpful
 - d) little or no help
 - e) not applicable

Analysis

- Internal consistency: - related questions; paired course sections; compare science/engineering students (figure ↓).
- For each question **helpfulness score** = Percentage of respondents saying *extremely* or *very helpful*.
- Rank experiences in order of "most helpful" ... Discuss results with each instructor.
- Compare impacts of 4 intervention types:
 - x = RBIS** introduced during a full 2-3yr course transformation project
 - c = RBIS improved by consulting with STLF*
 - i = RBIS changes made largely by the instructor alone (often after working with STLFs*)
 - n = basically little or no RBIS introduced.
- Processing: sorting, ranking, correlating, plotting

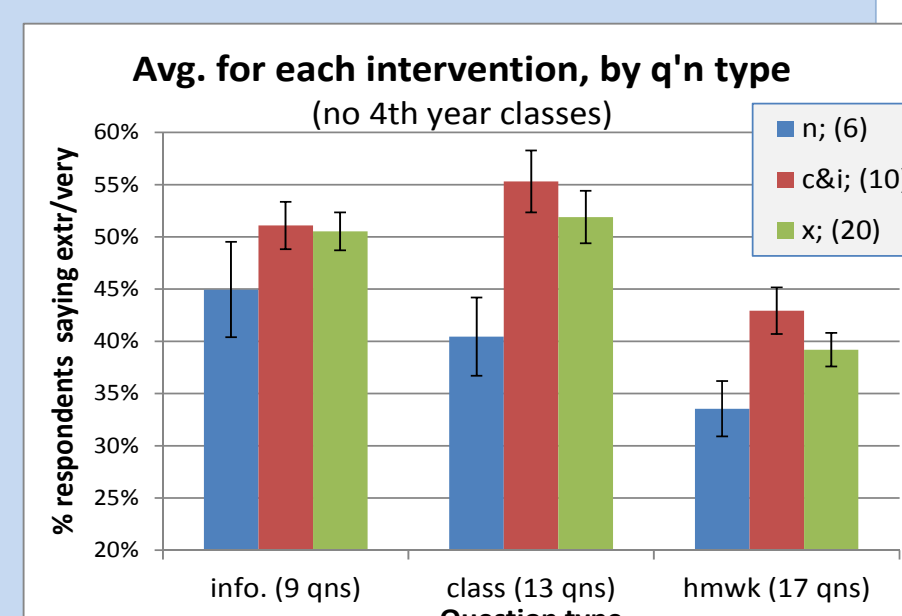
* Science Teaching & Learning Fellows (education support); see ref. 5. **RBIS = Research Based Instructional Strategies.



Some learning experiences students found "extremely or very helpful"

Do students perceive courses with RBIS interventions as more helpful than those without?

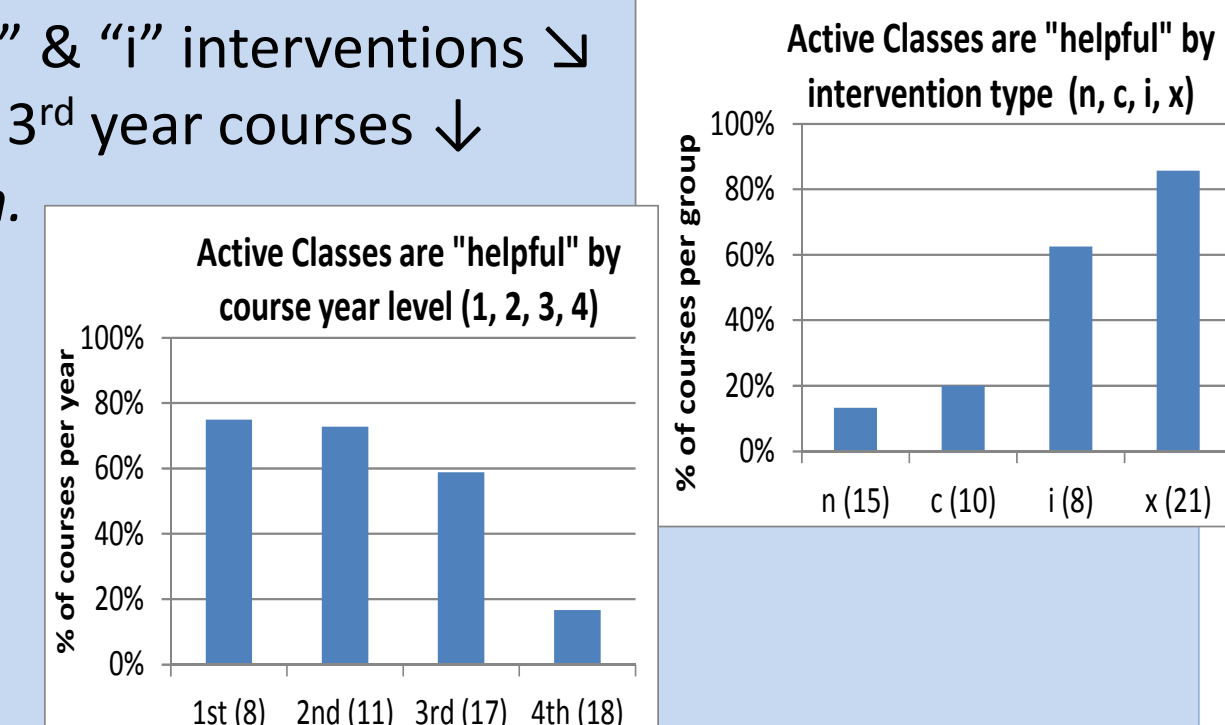
- Classroom practices see the greatest distinction between "x", "c", "i", and "n" courses.
- Impacts on 4th year (senior) classes are less distinct.



Classroom strategies:

How does perceived helpfulness of active strategies relate to intervention type?

- Over 1/2 of respondents said extremely or very helpful in most courses with "x" & "i" interventions ↓
- Over 1/2 of respondents said extremely or very helpful in 60-75% of 1st, 2nd, & 3rd year courses ↓
- 4th year courses are variable, smaller, more 'expert-like', and more hands-on.

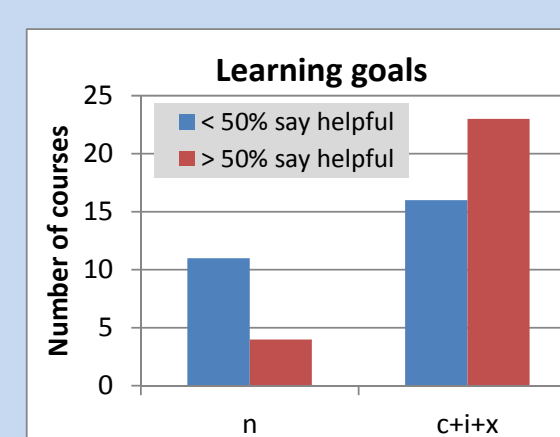


Classroom strategies egs: Average "helpfulness score" per class:

	Avg %	Range %	Stdev %	Comments
Clickers (17 courses)	77	55 – 92	10	- Clickers perceived as helpful
Clicker Discussions	55	38 – 77	12	- Discussions could improve
Lecturing	75	22 – 100	18	- Lecturing prominent & variable
Socratic lecturing	54	9 – 88	19	- Socratic lecturing can be helpful

Information provided

- Textbook not well-used in most (although not all) courses.
- Instructor's lecture notes: most important source for most students.
- Are instructors spending too much time creating notes & content?

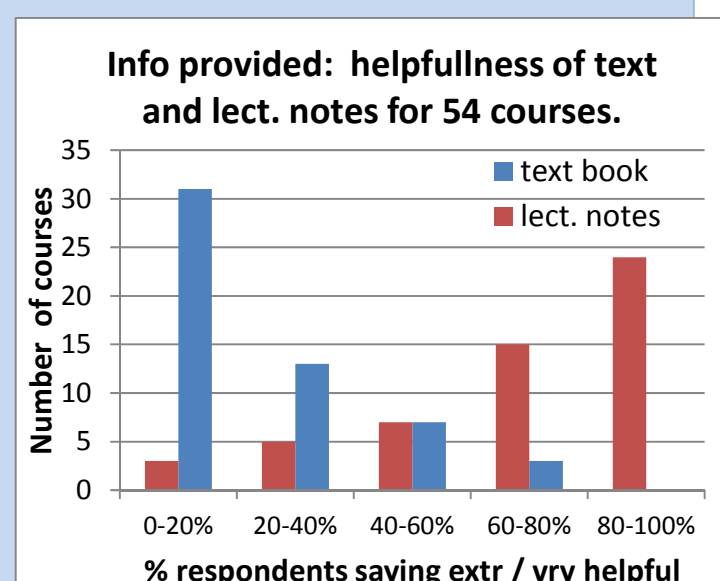


Learning goals

- Number of courses with low or high helpfulness scores for learning goals. With no intervention goals were less useful.

Homework and feedback

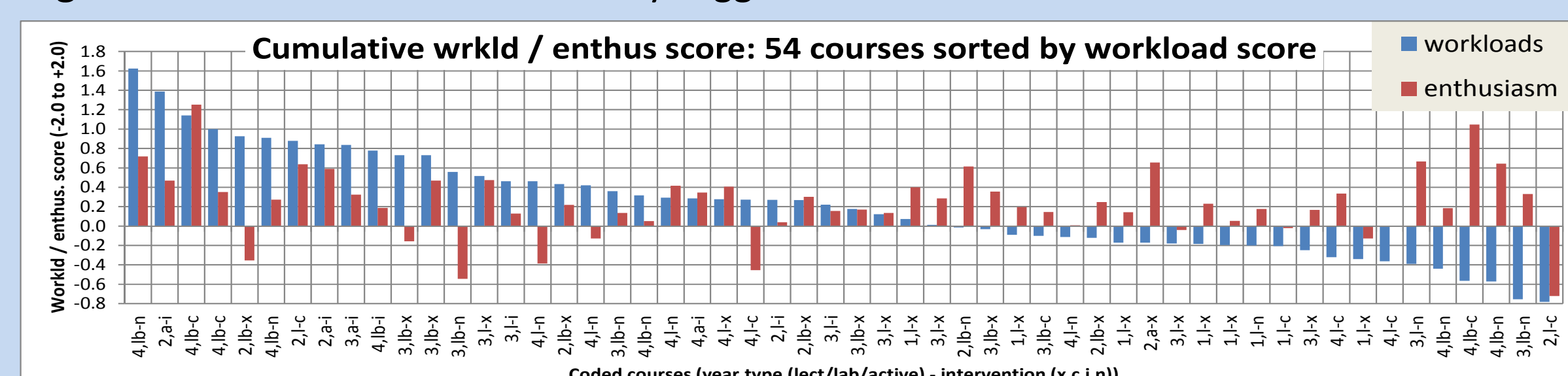
- Online quizzes: Helpfulness pattern is very similar to "active classes" by intervention and year (above).
- Group studying was MORE helpful than Solo studying in 11 of 54 courses; mostly courses that encourage group work.
- Rubrics: > 50% of respondents say they are extremely or very helpful in 19 of 54 courses.
- Feedback on preliminary work: >50% say is extremely or very helpful in 17 of 54 courses.
- But ... homework saw surprisingly "low" endorsement overall. (An area worth improving.)



Workloads and enthusiasm

Question: "Compare this course to each other course you take." Answered by >2300 students taking EOAS courses.

- Enthusiasm for EOAS courses rarely "negative" (negative = less enthusiasm).
- High workload + Low enthusiasm may suggest de-motivated students.



Eg. of a single course (5th from left above): A difficult, required, math / computing course with broad demographics had ... 3rd highest "active class helpfulness" and 5th highest "workload" yet 5th lowest "enthusiasm".

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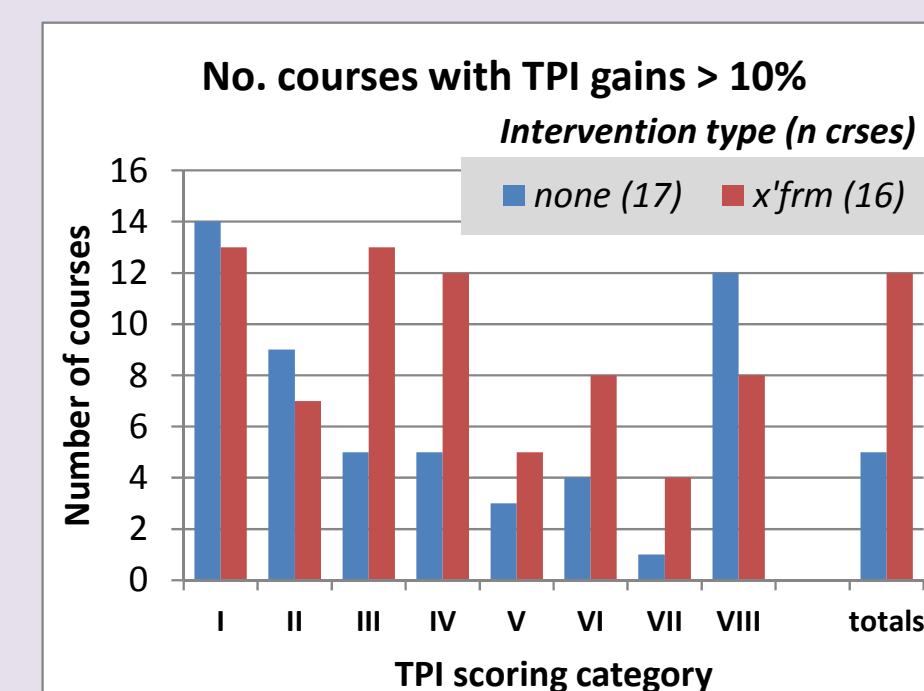
INSTRUCTOR PERSPECTIVES: Teaching Practices Inventory = TPI²

- Self report; most EOAS instructors; both 2006/7 & 2012/13
- Questions (many yes/no) in 8 categories.
- Scoring rubric was developed for each category.

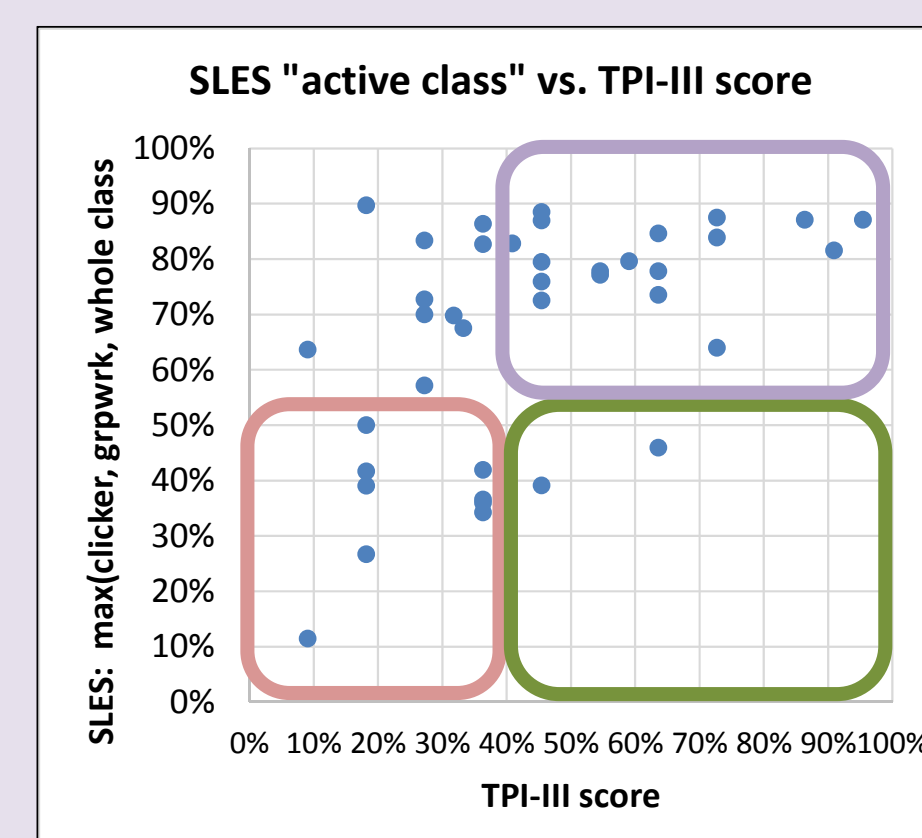
- I. Course information provided to students
- II. Supporting materials provided to students
- III. In-class features and activities
- IV. Assignments
- V. Feedback and testing; including grading policies
- VI. Other (check all that occurred in your course)
- VII. Use of Teaching Assistants
- VIII. Collaboration or sharing in teaching

Do instructors say active classroom strategies improve??

- Figure: # courses with n=none or x=x'frm interventions with TPI gains > 10%.
- "Totals" bars: overall 5 of 17 "n" and 12 of 16 "x" courses saw TPI scores increase by > 10%.
- Categories III, IV, VI: More "x" courses than "n" courses improved.
- Categories I, II, V: Similar improvement in all courses.
- Categories V, VII: Less improvement.



Correlating TPI² and SLES¹ (39 courses)



Students & Instructors apparently "agree" about active classes.

- High TPI-III scores correlate with high SLES "helpfulness".
- Low SLES "active classes helpful" correlates with low TPI-III.
- Only 2 / 39 courses have high TPI with low SLES scores; these instructors say "active" with students saying "not helpful".

Also ... TPI evidence of change in Teaching Culture:

Compare coded answers to the open-ended question:

"What is the biggest BARRIER to achieving more effective student learning in your course?"

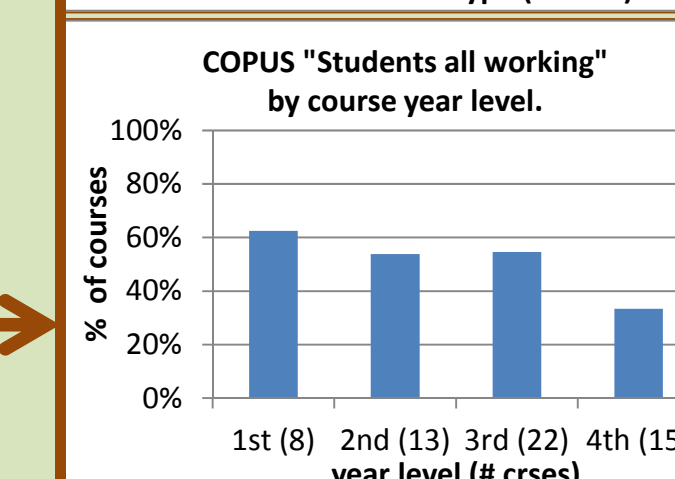
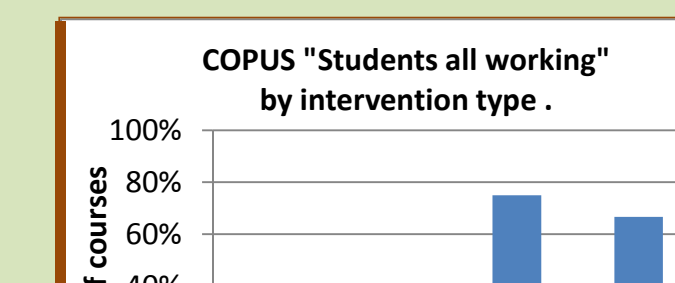
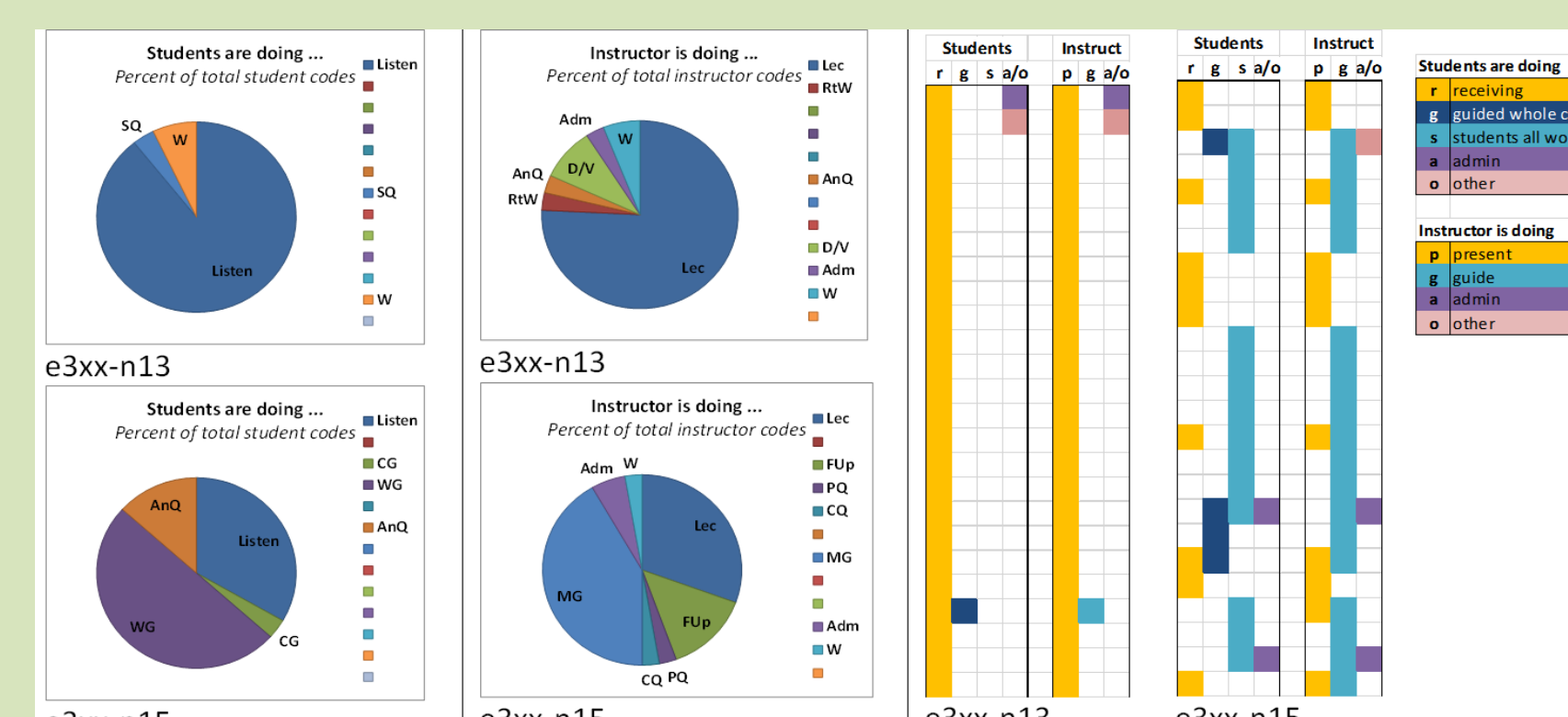
- 2006/7: Most responses referred to *inadequacies of students and class space*.
- 2012/13: Most responses referred to *insufficient instructor time and expertise*.

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OBSERVER PERSPECTIVES: Classroom Observation Protocol = COPUS³

Example: results from observing two different classes of one course:

- Top pie charts (left timeline) → straight lecture (clicker hardware failed).
- Bottom pie charts (right timeline) → 40-min group-based work-sheet activity.



Active strategies are prominent in "i", "x" and 1st, 2nd, 3rd year courses.

Correlating COPUS³ and SLES¹ w.r.t. active classes (42 courses)

- Students in most courses say active classes are "helpful".
- Activity observed in these classes averages 59% of 2-min intervals (σ = 24%). (Spending roughly 50% of class time as "active" is significant.)
- Low SLES "active class helpful" correlates with low COPUS score.
- NO high COPUS score with low SLES scores. i.e. No "active" classes were observed that students said were "NOT helpful".

