Is more activity always better?

A department-wide study of relationships between classroom practices and student performance

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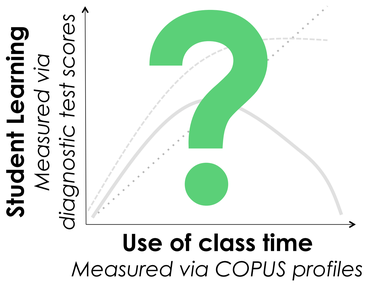
Research Questions & Data Collection

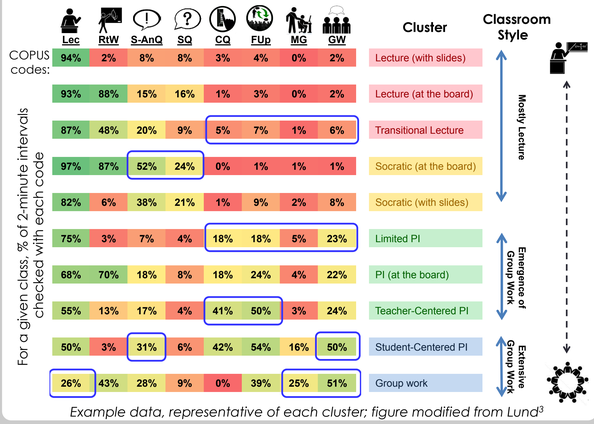
- What variety of teaching practices are currently used in the biology program at UBC?
- What are the relationships between specific classroom practices & student learning?



Goal: identify these relationships to inform teaching practice

Characterizing Classrooms using COPUS[1,2]:

During a classroom visit, student and instructor activity codes are checked off in 2-min intervals. Each classroom can then be clustered:



Example data, representative of each cluster; figure modified from Lund[3]

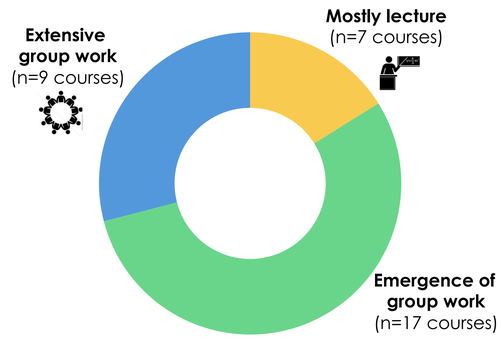
Observational & performance data collected

Course Level	# of Course sections (# unique courses)	Total # of matched students (proportion of course enrolment)
100	13 (2)	1431 (47%)
200	9 (4)	1723 (64%)
300	5 (5)	463 (53%)
400	6 (6)	111 (62%)
Totals:	**33** (17)	**3728**

- Each course was observed for a 'typical week' (~3 hours)
- **17** diagnostic tests consisting of a total of **165** questions, compiled largely from validated questions in the literature.
- Matched students wrote the test pre- and post-course

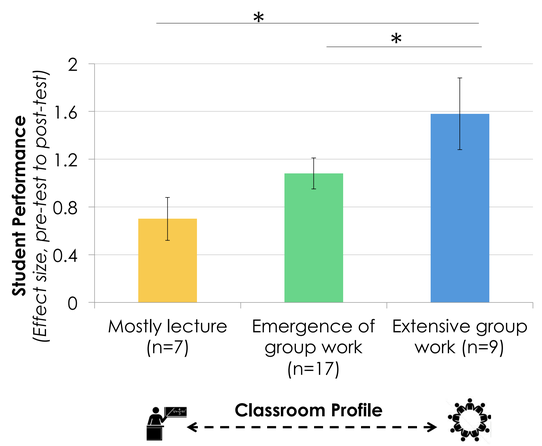
Classroom characterization

Classroom styles in our biology courses



- Classroom styles assessed from clustering averaged COPUS data.
- Evidence-based, active learning teaching practices are quite prevalent across the biology program.
- Most active classes are large-enrolment, lower division courses.

Student performance and classroom styles



- Students in 'extensive group work' classes perform significantly higher than students in other classes.
- This is consistent with an overall trend: **evidence-based, active learning practices contribute more to student learning than traditional lecturing.**

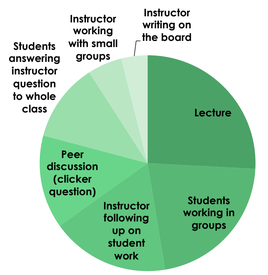
*Error bars are SEM; * p<0.05.*

"Student Performance" is the effect size of the difference between pre- and post-test diagnostic scores within each class section, calculated using the standardized mean gain[5]:

$$Effect\ Size = \frac{\bar{x}\ post\ test - \bar{x}\ pre\ test}{s_p}$$

"Bright Spots"

Instructional practices in the top performing class sections:



Relative proportion of classroom activities in the four classes with the highest student performance

Specific classroom practices

Time spent on group work, but not lecturing, predicts student performance

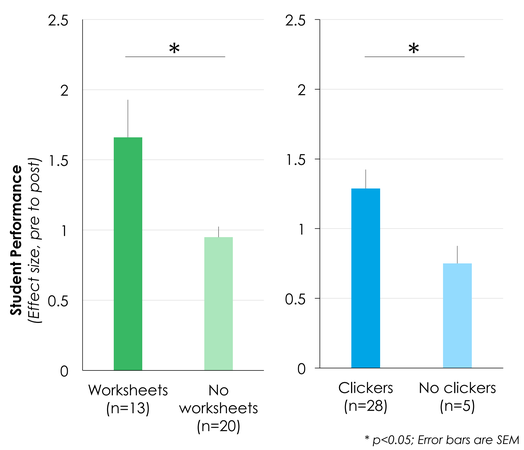
- Consistent with literature[4], classes with more student-centered time have higher performance.
- Maximum % group work observed was 63% of class; unknown impact beyond that.

Worksheets & peer instruction support student learning

In our classes, the most common student-centred activities are:

- Clicker questions (peer instruction)
- Worksheets
- Individual problem-solving
- Asking/answering questions to the whole class

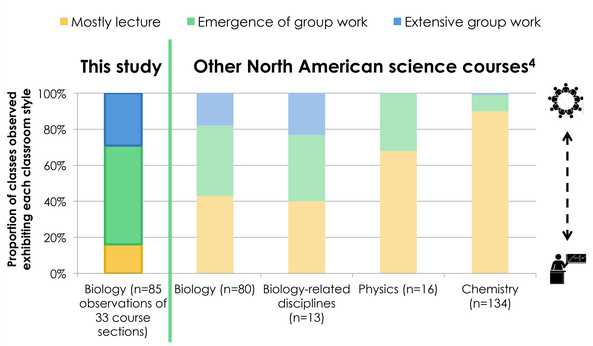
Students in classes that include **any** worksheets or **any** clicker questions significantly outperform those that do not.



** p<0.05; Error bars are SEM*

'Science Education Specialist' Model

Comparison to departments in other universities



- Student-centred practices at UBC: less lecturing, more group work
- Impact of '**Science Education Specialist**' (SES) model of educational change: Significant, multi-year institutional initiatives with departmental support for the integrated SES individual(s)

Conclusions & Next Steps

- We have quantitatively linked program-wide class observational data with student outcomes.
- **Suggestion: introduce worksheets or peer instruction into your class.**
- Questions: How to get the most out of the rich, time-series data?
- How to visualize / display the data, to encourage educational change?

Questions & ideas from you?

Research:
How would you approach further analyses? What questions would you ask?

Teaching:
How might these results impact your own teaching practices?

If interested in discussing or collaborating, leave a note!

Thank you to…

- the many Biology Instructors & students for their participation
- Leah MacFadyen & the LAVA group for discussion on analysis

This work was performed under institutional behavioural research ethics approval, by the UBC Office of Research Ethics

References

[1] Smith M *et al*, CBE - Life Sciences Education (2013) 12(4):618-627.
[2] Smith M *et al*, CBE - Life Sciences Education (2014) 13(4):624–635
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