Mind the Gap: how active learning can improve equity in STEM classrooms

Elli Theobald
University of Washington
ellij@uw.edu

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Educational Inequities

Taylor 2018, California Prop 98 Analysis
Educational Inequities

Terminology

Opportunity Gap (Achievement Gap)
- Quinn et al. 2020
- the74million.org – some (not all) are calling it a racist idea

Differences, Inequities
- “It’s a problem if you’re an 8th grader and you’re reading on a 2nd grade level.”
  – Lynn Jennings (The Education Trust)

BIPOC, PEER: Persons Excluded due to Ethnicity and Race
- Asai 2020 – Race Matters
- Asai 2020 – Excluded

Inequities (differences) in our classroom are because of context
Educational Inequities

1) Completing a 4-year degree is the biggest driver in income inequality

2) STEM workforce cannot meet demand

3) Increasingly complex problems

Talke et al. 2011; PCAST, 2012; Pell Institute 2015
Educational Inequities

% Students who met or exceeded standard

Taylor 2018, California Prop 98 Analysis
Educational Inequities – Gen Chem

GPA Difference (PEER – nonPEER)

Course Survival Probability

Controlling for SAT+HSGPA

Harris, Theobald et al. 2020, Science Advances
Educational Inequities

Sarah Keller
Mathematical reasoning, affect, and metacognition

Munira Khalil
New chair; Activate Chemistry

Colleen Craig
Activate Chemistry; Collaborative and frequent two-stage exams; Wise Schooling

Larry Goldman
Mathematical reasoning, affect, and metacognition

Debbie Wiegand
Active learning chemical demonstrations
Need to Fix our Institutions

What can I do in my classroom?

Is active learning a solution?

Active Learning:
• Engages students in the process of learning
• Activities and/or discussions (as opposed to listening to an expert)
• Often higher order thinking
• Often Group work
Driving Questions

• Is active learning effective across contexts?

• Can active learning promote equity?

• Classroom Implications?
Meta-Analysis: STEM Active Learning

Mariah Hill, UW Biology post-bac
Elisa Tran, UW BioChem post-bac
Scott Freeman, UW Biology

29 Additional Coders (graduate students, postdocs, etc.)
Update to Freeman et al. 2014

Freeman et al. 2014
Papers June 1998 – January 2010
• 158 studies total

Current (the Update)
Papers January 2010 – June 2016
• 133 studies total (232 case studies)

More information about the papers

What is it about active learning that is effective?
• Type of Active Learning
• Active Learning Intensity
• And other course characteristics
Exam Scores

Active Learning vs. Traditional Lecturing

Theobald et al., *In prep*
Exam Scores
Active Learning vs. Traditional Lecturing

Theobald et al., In prep
Exam Scores
Active Learning vs. Traditional Lecturing

- Many different types of Active Learning are effective
- Active Learning is effective in any Course Level or Class Size and in any Subject
- Low-intensity Active learning is not much better than lecturing

Theobald et al., In prep
Driving Questions

• Is active learning effective across contexts?
  Yes! Across: type, class size, course level, subject area, high intensity

• Can active learning promote equity?

• Classroom Implications?
Can active learning promote equity?

Individual Participant Data Meta-analysis
Passive Lecture vs. Active Learning

Raw, disaggregated data

<table>
<thead>
<tr>
<th>Exam Score</th>
<th>Passing rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 Studies</td>
<td>26 Studies</td>
</tr>
<tr>
<td>9,238 students in 51 sections</td>
<td>44,620 students in 170 sections</td>
</tr>
</tbody>
</table>

Total: 53,858 students from 37 studies

< 14% studies

Hierarchical Bayesian Regression

Contacted every author from 291 studies

Theobald et al. 2020, PNAS
Can active learning promote equity?

A

Difference in Exam Score (sd)

Passive  |  Active
---------|---------
-0.50    | -0.75

33% Reduction

B

Difference in Passing (%)

Passive  |  Active
---------|---------
-7.50    | -10.00

44% Reduction

Theobald et al. 2020, PNAS
Can active learning promote equity?

Theobald et al. 2020, PNAS
Can active learning promote equity?

Low Intensity <33%

High Intensity > 66%

What is it about high intensity active learning?
The Heads and Hearts Hypothesis

Educational Inequities

Disrupt Inequities

Culture of Inclusion

Instructor Soft Skills
- Interest in success
- Confidence in students
- Care & community

Disproportionate benefit
- Psychosocial Comfort
- Belonging

Deliberate Practice

High intensity active learning
- Focus on challenges
- Scaffolded, PCK
- Immediate feedback
- Group work

Disproportionate benefit
- Repeated practice
- Intentional feedback
- Normalize struggle

Theobald et al. 2020, PNAS

Driving Questions

• Is active learning effective across contexts?
  Yes! Across: type, class size, course level, subject area

• Can active learning promote equity?
  Yes! Especially active learning that engages students for > 2/3 of class time

• Classroom Implications?
  Keep going!
  Fix the institution in your classroom
  …and outside of your classroom.
Thank you!!

Mariah Hill, UW Biology Post-Bac

Elisa Tran, UW Biology Post-Bac

Scott Freeman, UW Biology

29 Additional Coders (graduate students, postdocs, etc.)

Sarah Eddy, Florida International University, Biology

All of the Authors who contributed data

Ailene Ettinger
Ian Breckheimer
Kevin Ford
Janneke HilleRisLambers
Roddy Jenkins
Questions?

ellij @ uw.edu