Mind the Gap:

how active learning can improve equity in STEM classrooms

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BIOLOGY EDUCATION RESEARCH GROUP
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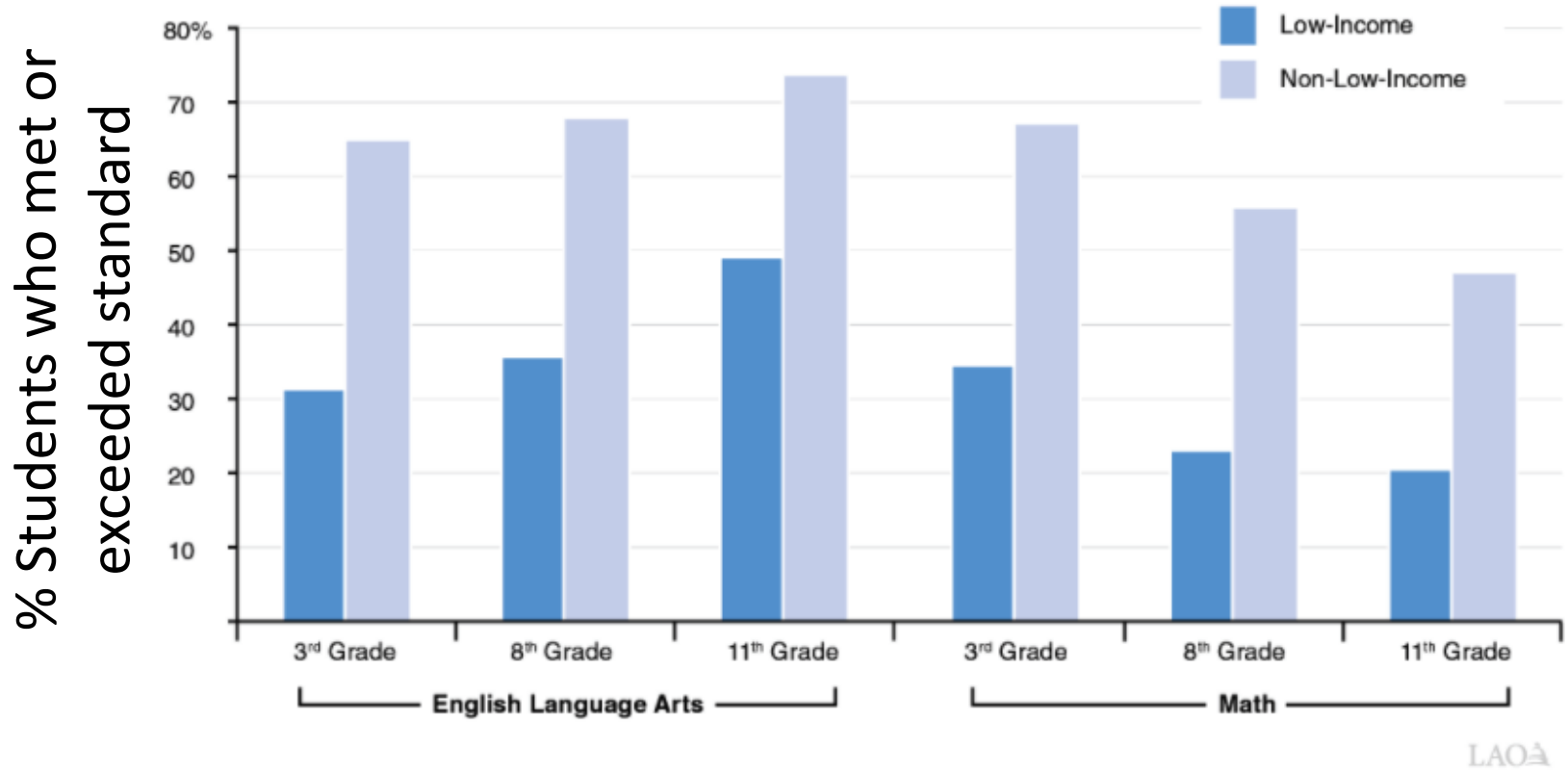
Educational Inequities



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

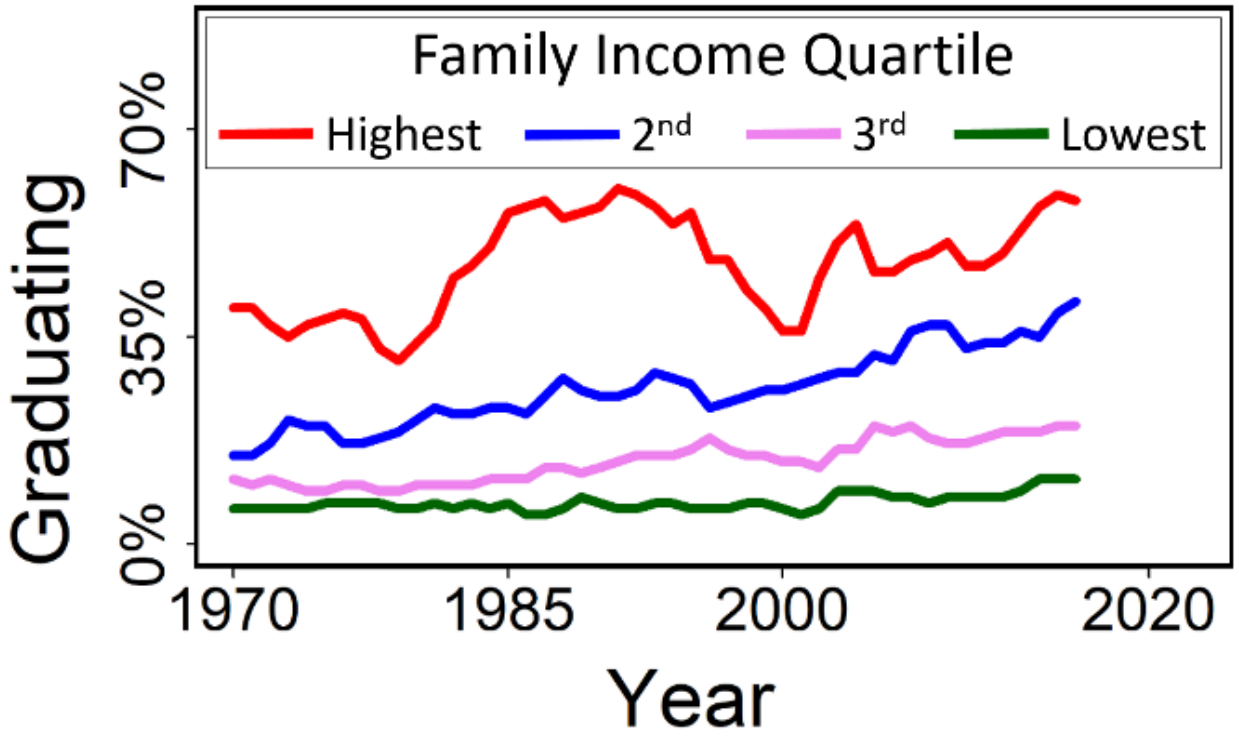
- Asai 2020 – Race Matters
- Asai 2020 – Excluded

"We need to fix our institutions, not our students."
Starlette Sharp

Inequities (differences) in our classroom are because of context

Educational Inequities

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



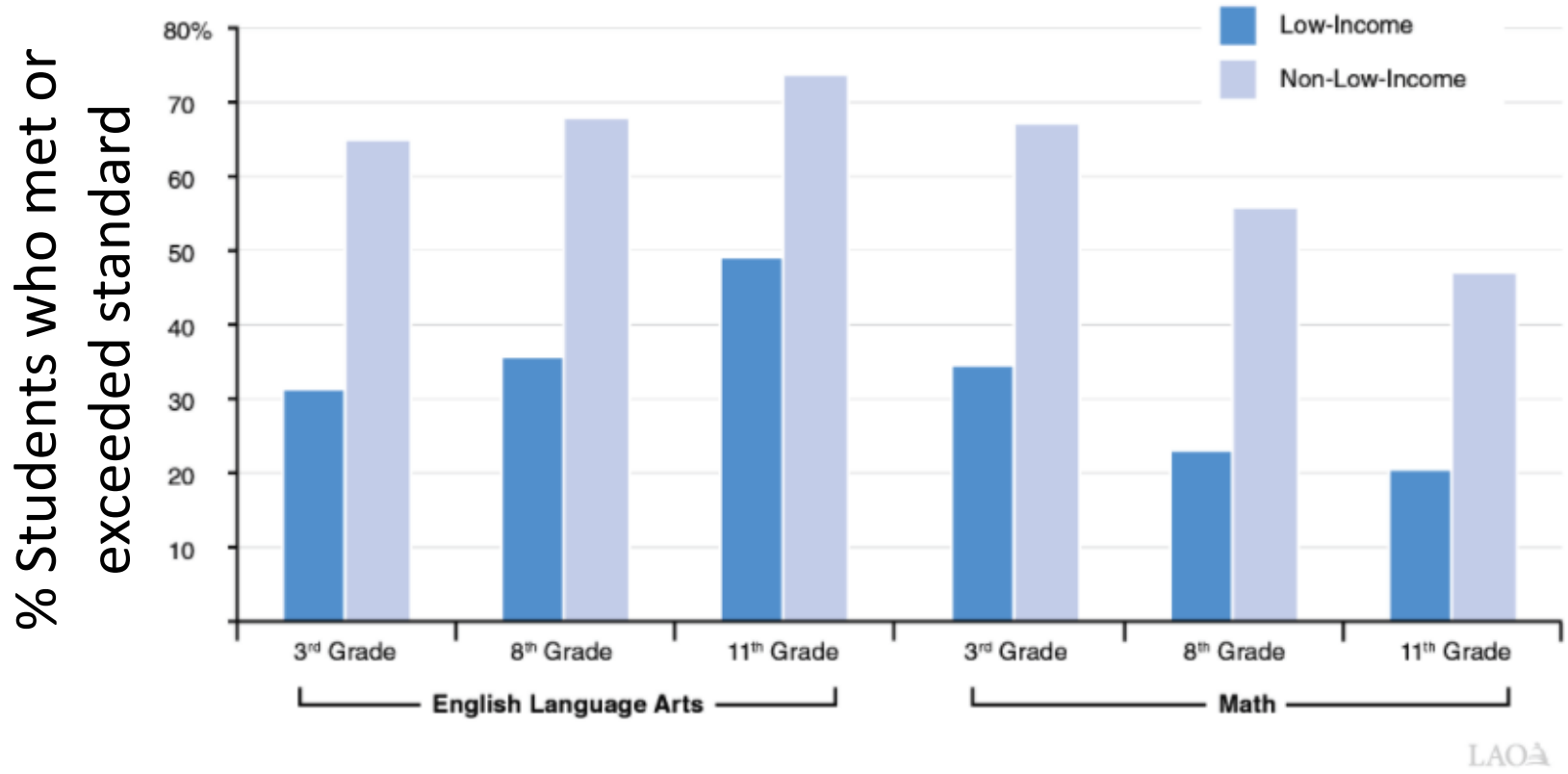
2) STEM workforce cannot meet demand

One Million More

3) Increasingly complex problems

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

Educational Inequities



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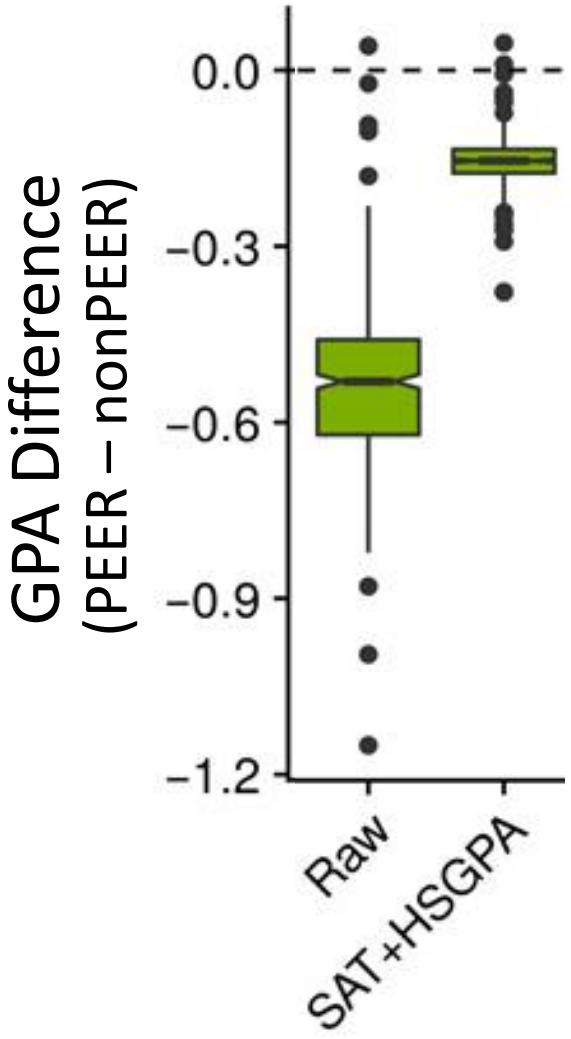
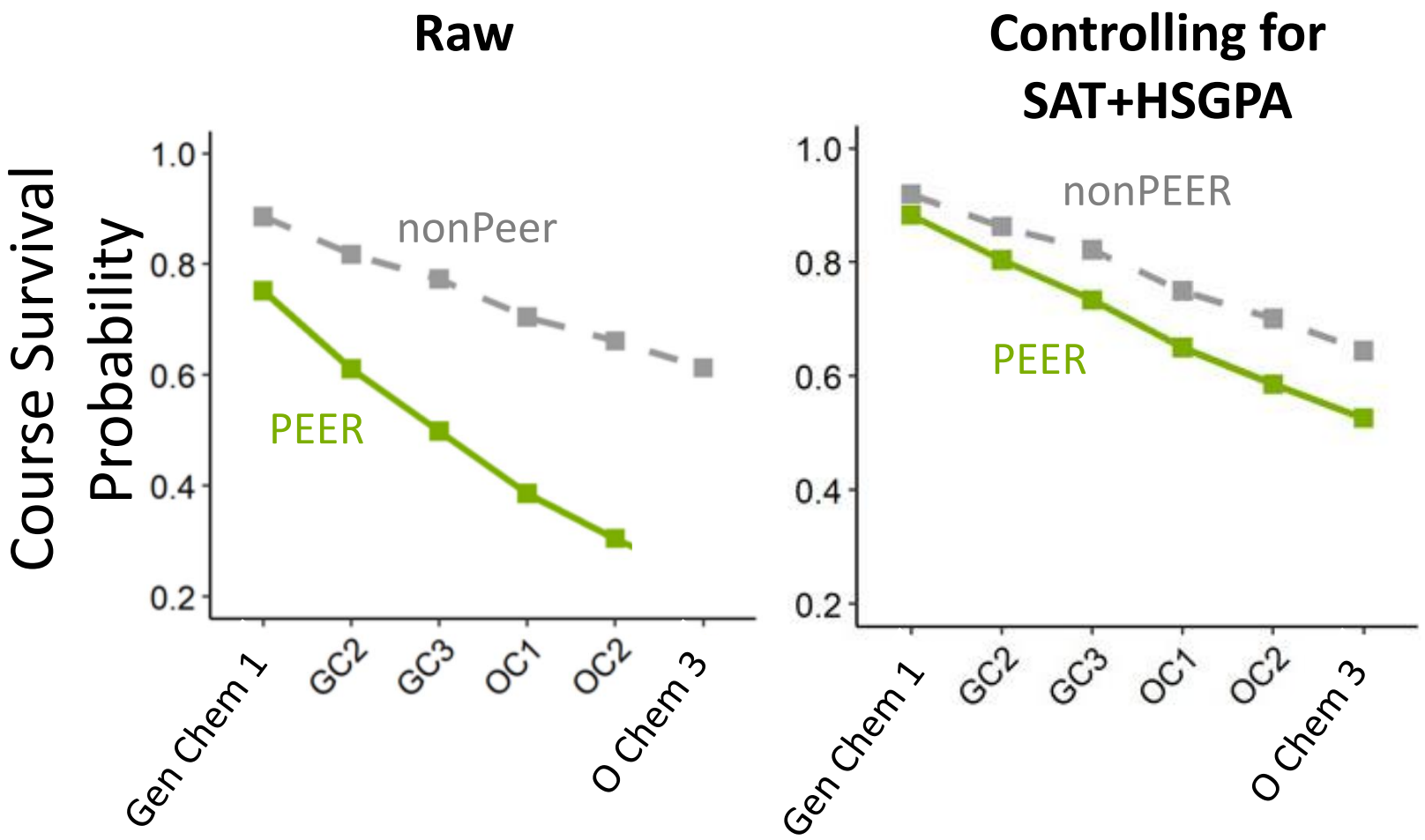
Educational Inequities – Gen Chem





Harris, Theobald et al. 2020, *Science Advances*

Educational Inequities

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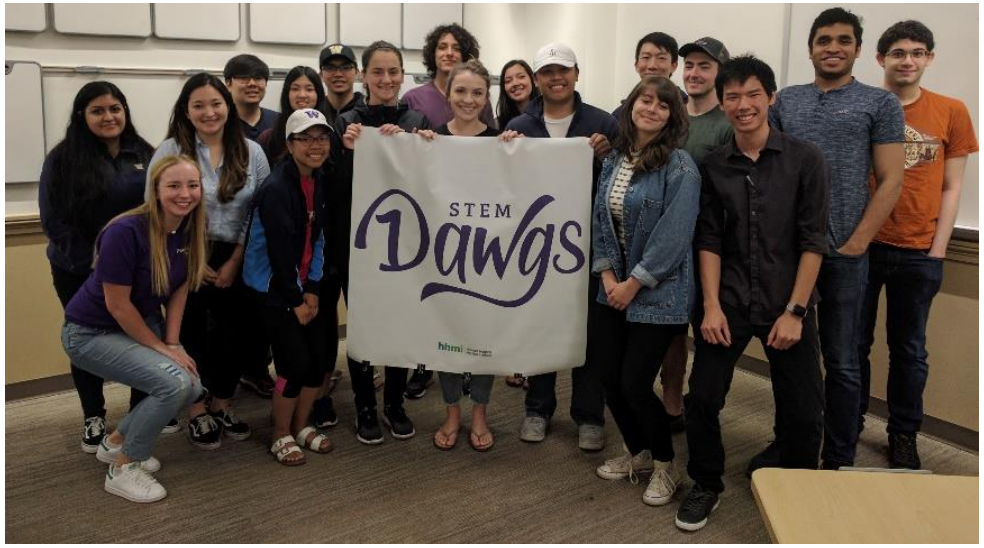


Sarah Keller
Mathematical reasoning, affect, and metacognition

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

ChEdR
Chemistry Education Research Group

Need to Fix our Institutions

What can I do in my classroom?

Is active learning a solution?

Active Learning:

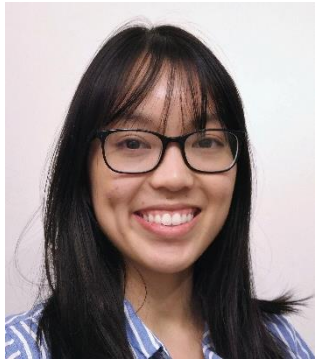
- Engages students in the process of learning
- Activities and/or discussions (as opposed to listening to an expert)
- Often higher order thinking
- Often Group work

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.)

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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

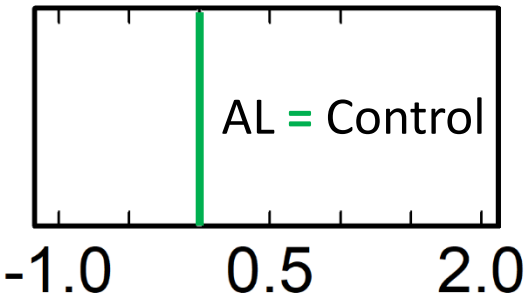
What is it about active learning that is effective?

- Type of Active Learning
- Active Learning Intensity
- And other course characteristics

Exam Scores

Active Learning vs. Traditional Lecturing

(n case studies)



"Effect of Active Learning"

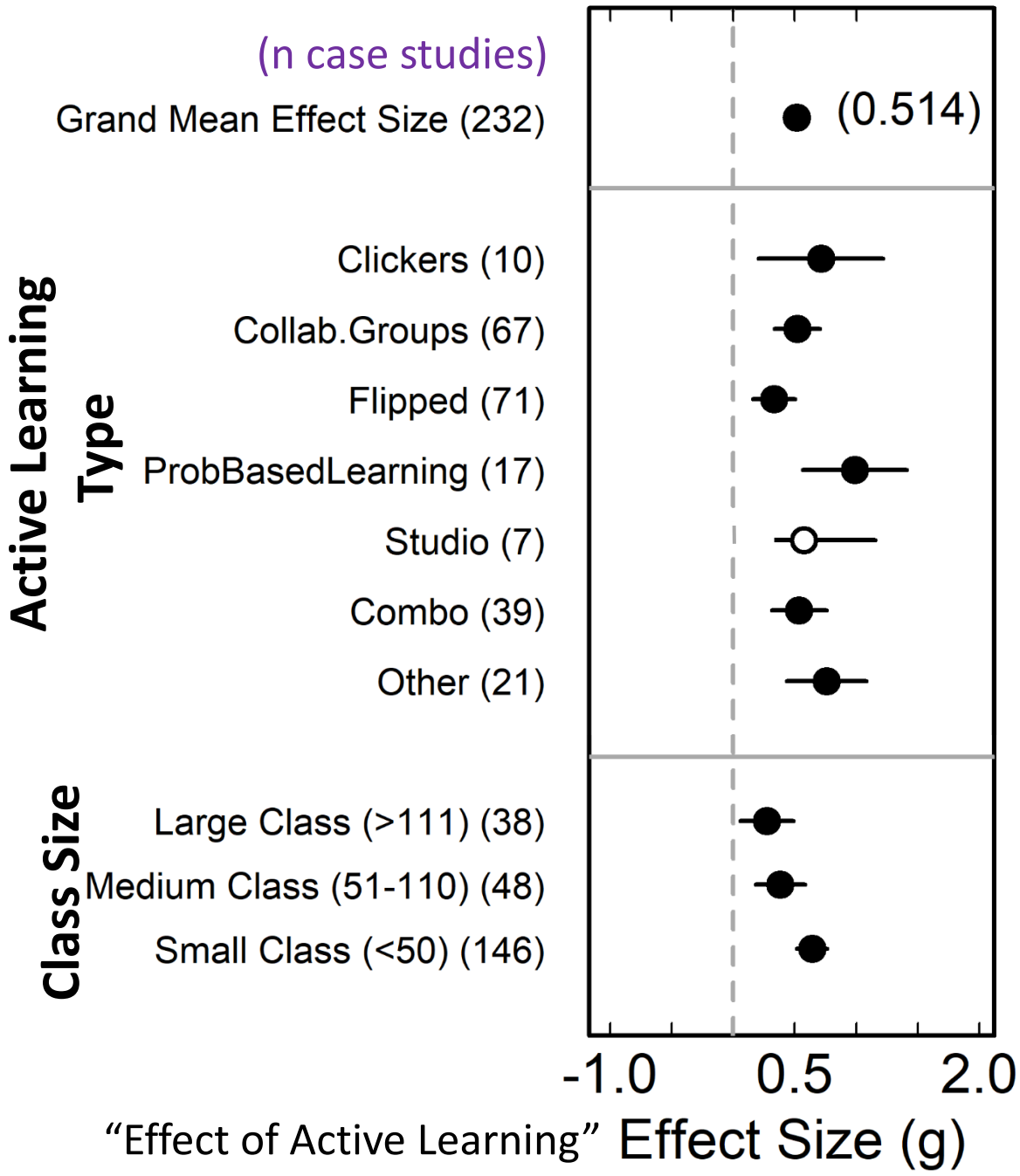
AL < Control

AL > Control

Theobald et al., *In prep*

Exam Scores

Active Learning vs. Traditional Lecturing

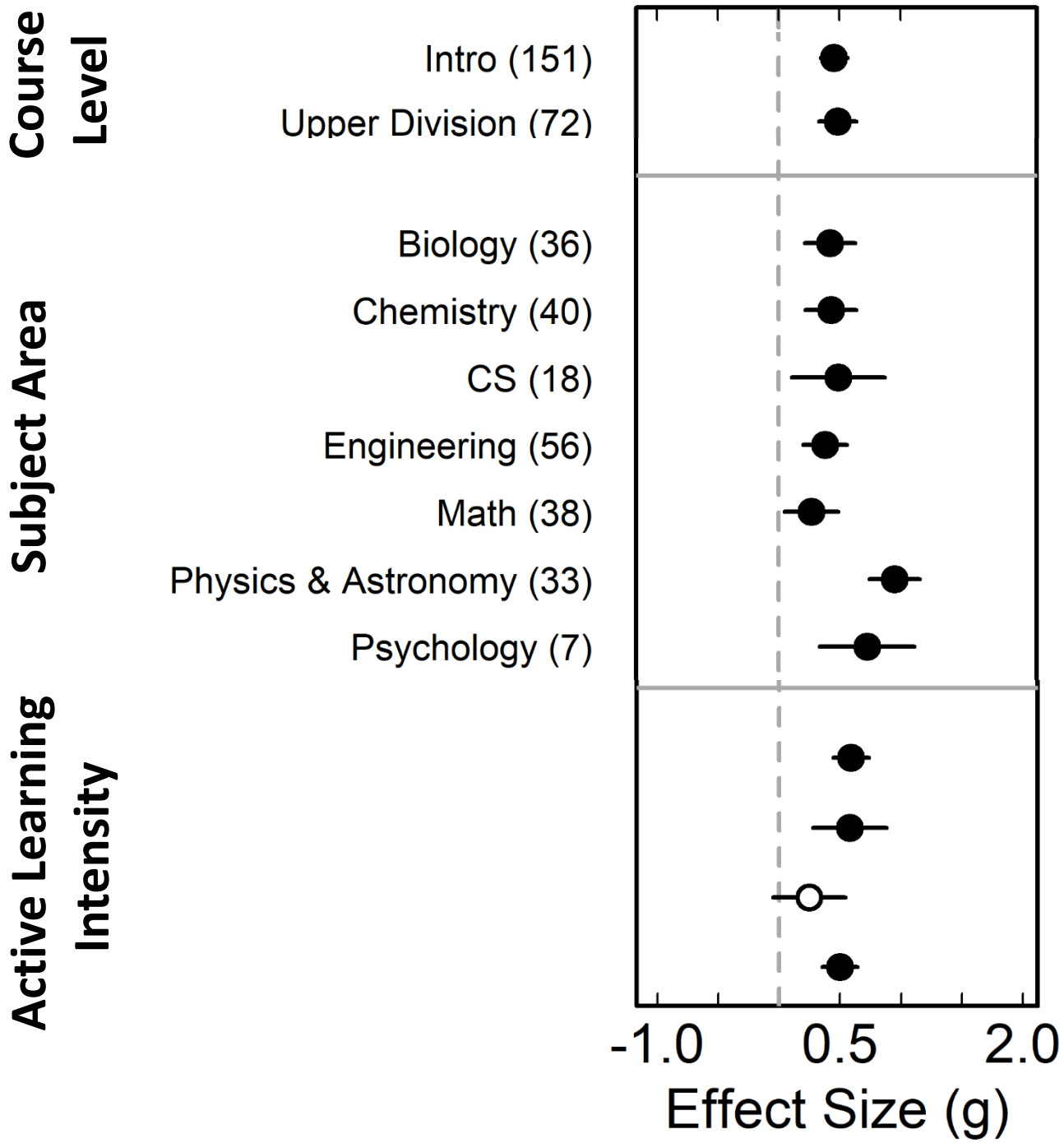


Theobald et al., *In prep*

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

Contacted *every* author from 291 studies

Raw, disaggregated data

Exam Score	Passing rate
15 Studies	26 Studies
9,238 students in 51 sections	44,620 students in 170 sections

Total: 53,858 students from 37 studies

< 14% studies

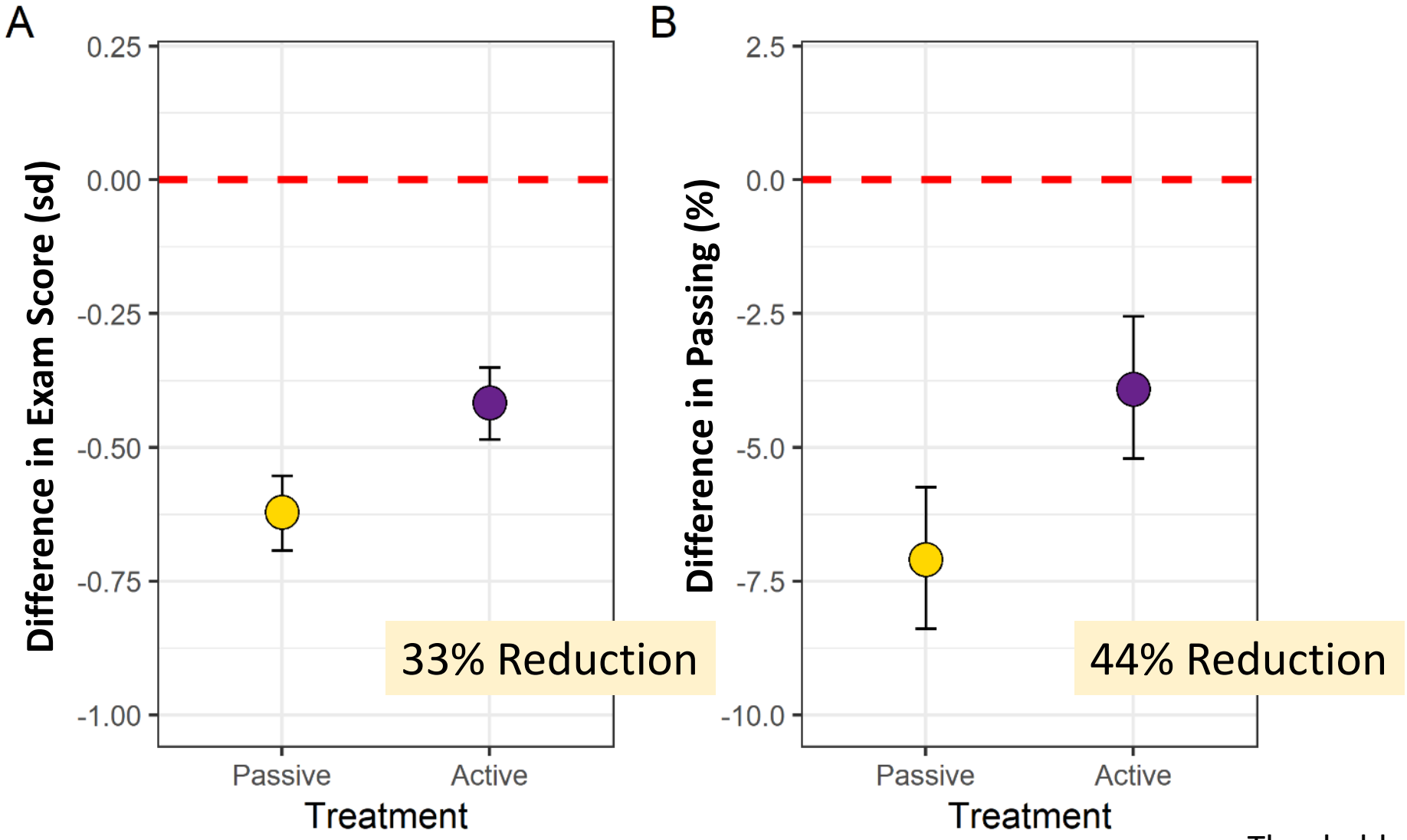
Race, Ethnicity, Family Income

Students from Minoritized Groups in STEM

Hierarchical Bayesian Regression

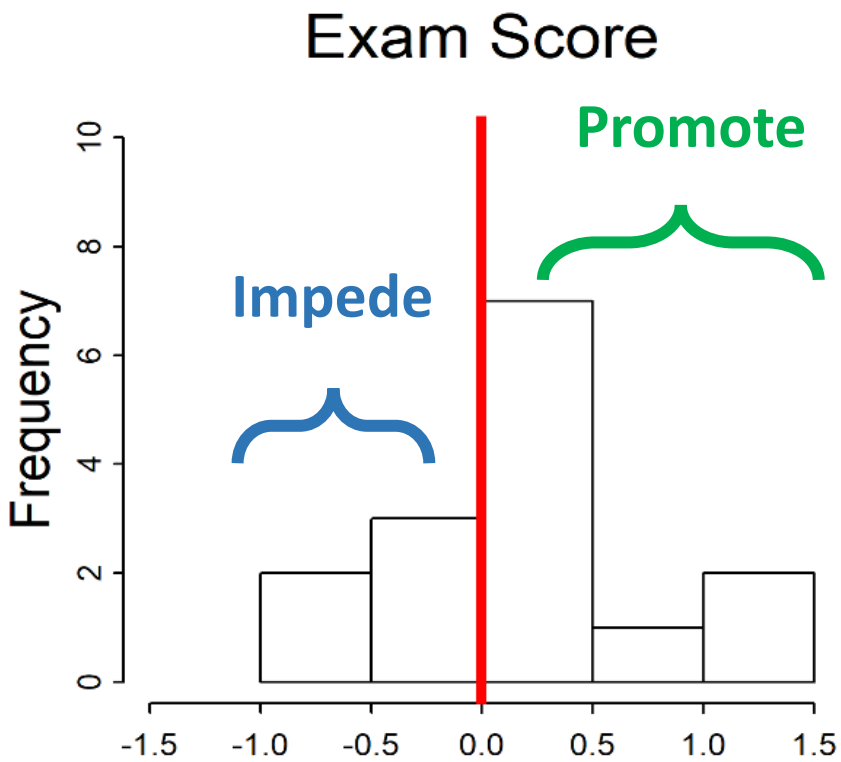
Theobald et al. 2020, *PNAS*

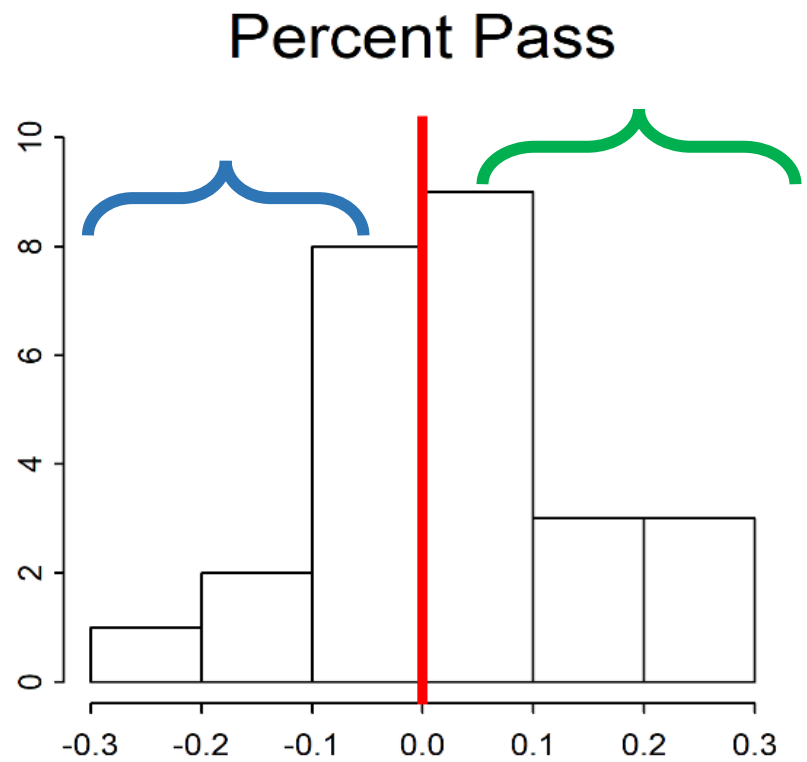
Can active learning promote equity?



Theobald et al. 2020, *PNAS*

Can active learning promote equity?





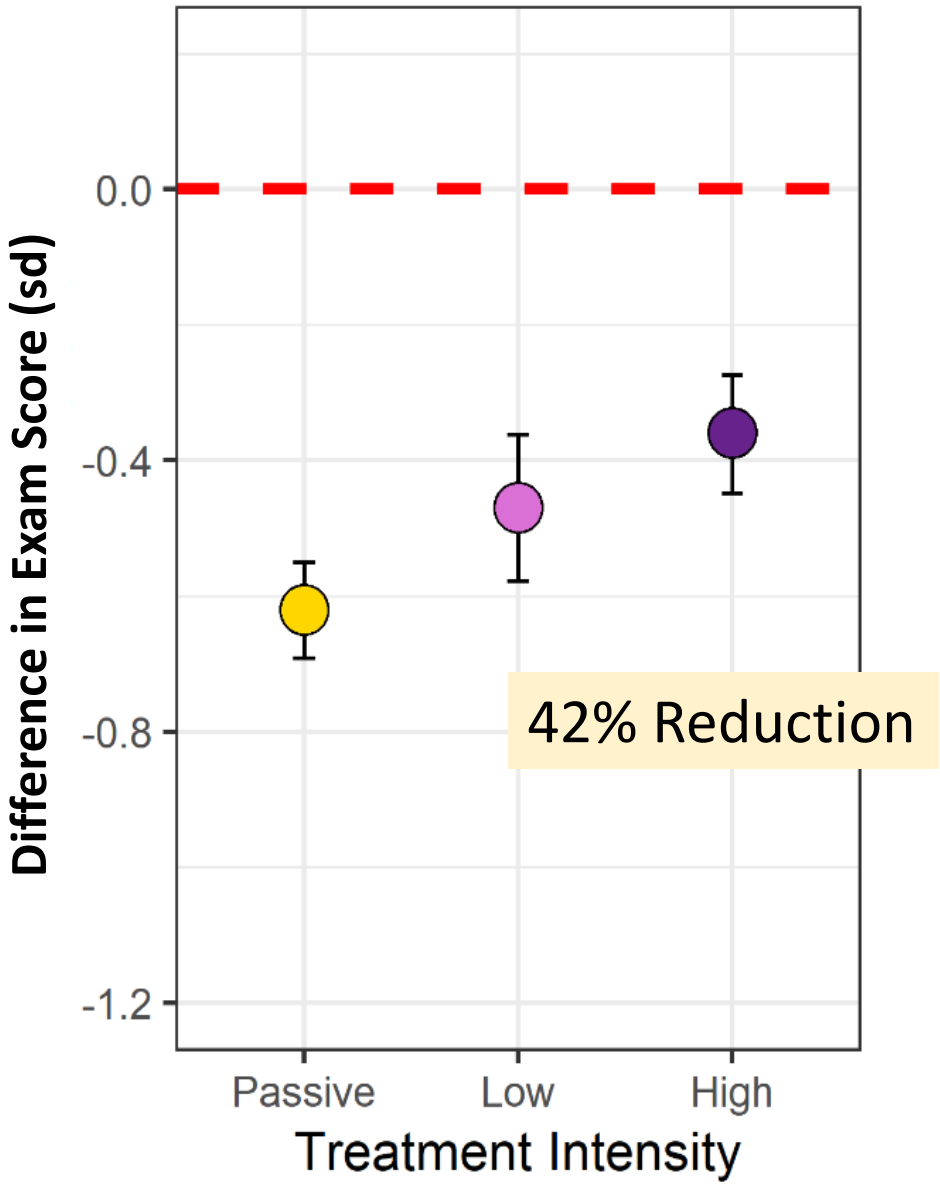
Theobald et al. 2020, *PNAS*

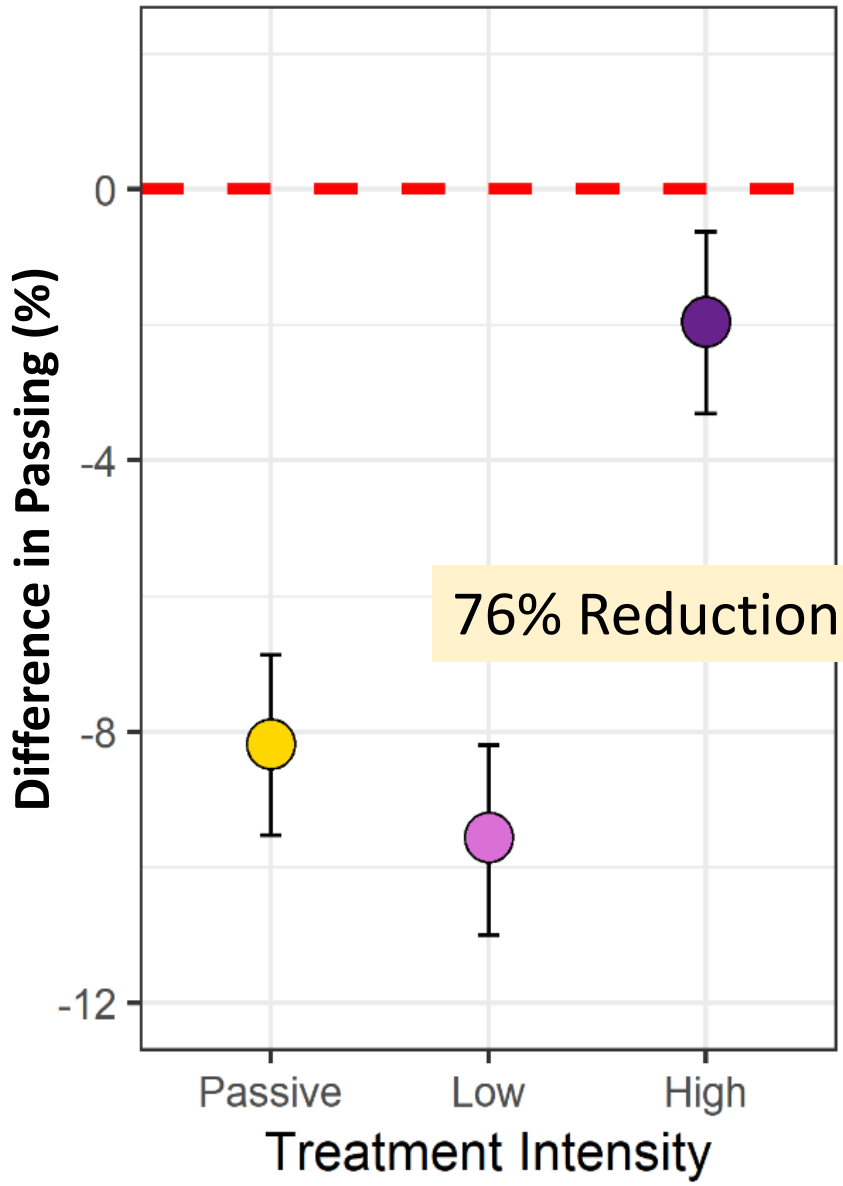
Can active learning promote equity?

Low Intensity <33%

High Intensity > 66%

What is it about high intensity active learning?





The Heads and Hearts Hypothesis

Sarah Eddy,
Florida International University, Biology

Educational Inequities

Disrupt Inequities

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

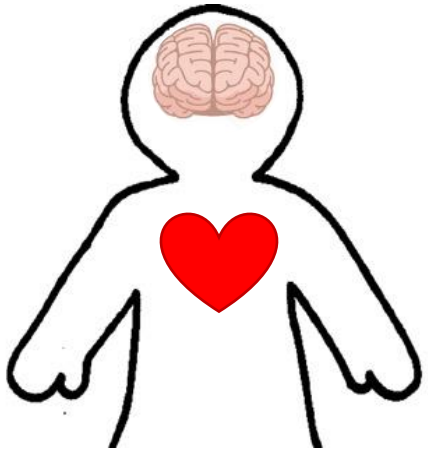
Deliberate Practice

Disproportionate benefit
- Repeated practice
- Intentional feedback
- Normalize struggle

Culture of Inclusion

Disproportionate benefit
- Psychosocial Comfort
- Belonging

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



Theobald et al. 2020, *PNAS*

Plant et al. 2005, Estrada et al. 2018, Steele 1997, Fries-Britt et al. 2010

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?

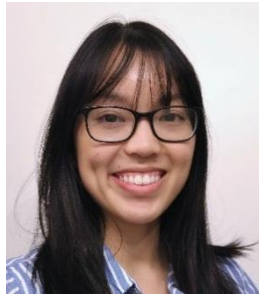
  Keep going!

  Fix the institution in your classroom

  …and outside of your classroom.

Thank you!!

Mariah Hill,
UW Biology Post-Bac



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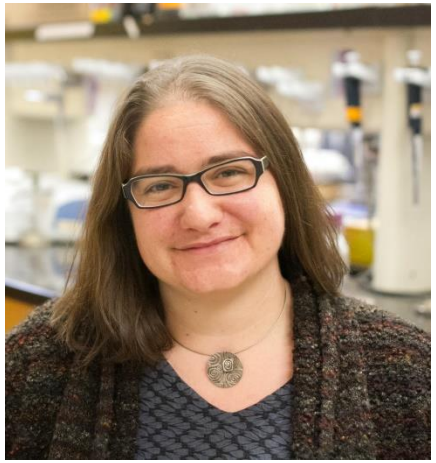

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Questions?

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