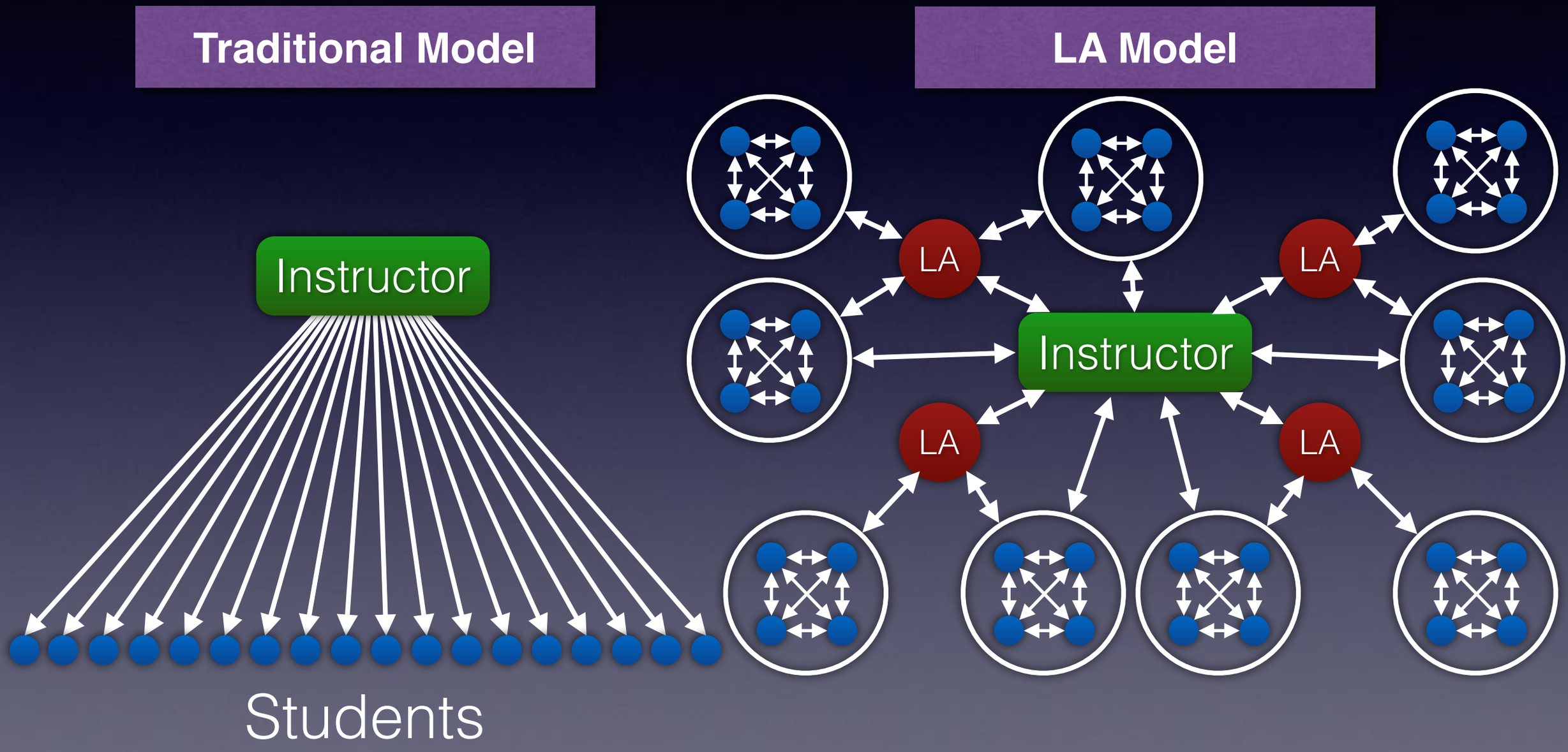
The Systemic Impacts of Learning Assistants

Ben Van Dusen[1], Jada-Simone S. White[1], Edward A. Roualdes[2]
[1]CSU Chico - Department of Science Education
[2]CSU Chico - Department of Mathematics and Statistics

Learning Assistant (LA) Model
UNIVERSITY OF COLORADO **BOULDER**

Learning Assistant Model



Van Dusen, B., Langdon, L., & Otero, V. (2015). Learning Assistant Supported Student Outcomes (LASSO) study initial findings. Proceeding of the American Association of Physics Teacher, 343–346.

LA Experience

Practice: Facilitate Small Group Learning

Content: Weekly Prep Meeting

a. What student problems have LAs observed?
b. What are the critical concepts for the coming week?
c. Where might students encounter difficulties?

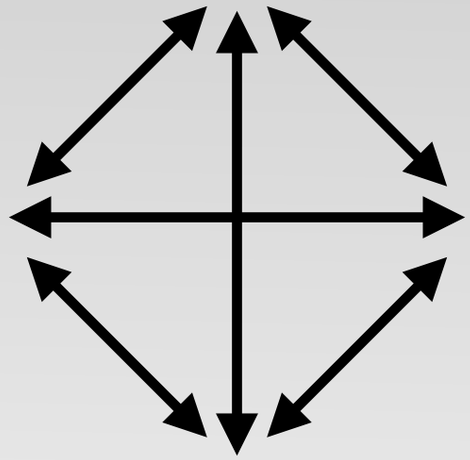
Pedagogy: LA Course

a. How do people learn?
b. What is wait-time
c. What are mental models
d. How do you ask open-ended questions

LA Program Goals

Discipline-Based
Education Research

Teacher
Recruitment &
Preparation



Transformation
of Departmental
Cultures

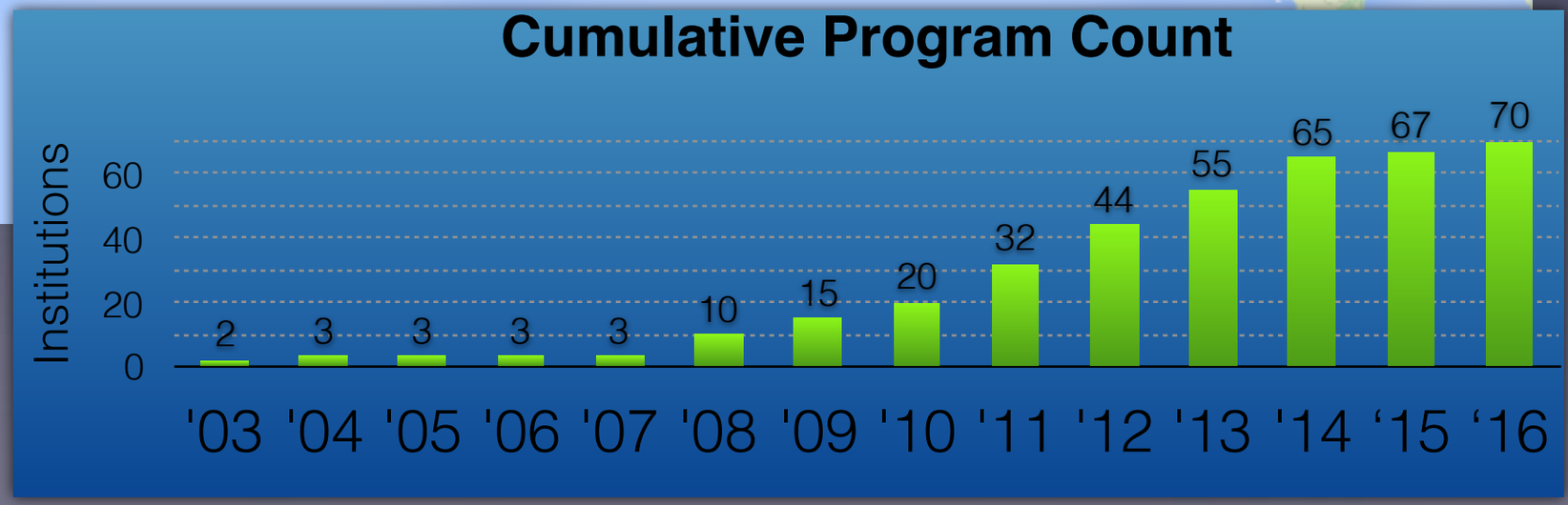
Undergraduate
Course Transformation
using LAs

Learning Assistant Alliance

Existing LA Programs
(International)

Developing LA Programs
(International)

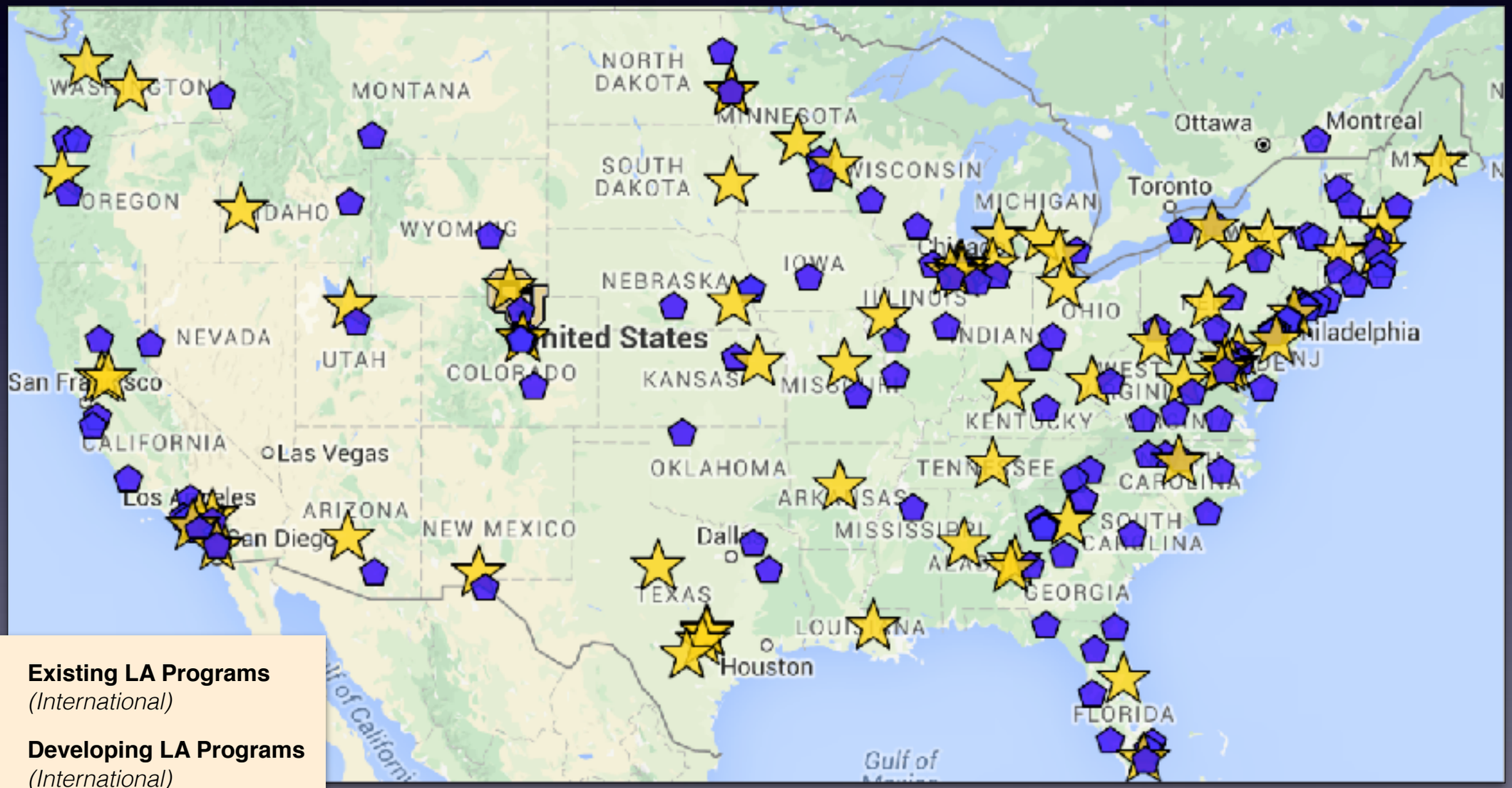
Developing LA Programs
(National)



Chico State (Fall '16)

Department	Courses	Funding Source
Science Education	SCED 141	CRT
Biology	BIO 151	MSTI
Math	MATH 119	CRT/MSTI
Physics	PHYS 202A, 204A	CRT/MSTI

Measuring impact of LAs on student learning



Existing LA Programs
(International)

Developing LA Programs
(International)

Developing LA Programs
(National)

Concept Inventories vs. Typical tests

- CIs are different from typical tests
  - based on extensive research
  - in students' own words
  - diagnose a specific level of student understanding
- Often have validity arguments
- CIs allow for normative comparisons

CONSTRUCTION OF OCI

Development Stage

Qualitative Methods

Phase 1. Develop OEQs

1. Identify critical concepts
2. Define learning goals
3. Develop and refine OEQs for IPEs
4. Interview experts and novices with OEQs for IPEs

Phase 2. Convert OEQs into MCQs

5. Administer IPE
6. Code & bin responses to IPE OEQs
7. Discard or keep OEQs
8. Use student language to write answer options
9. Convert OEQs into MCQs, and interview novices and experts with MCQs

Phase 3. Vet MCQs

10. Conduct think-aloud student interviews
11. Refine MCQs' language and figures, and interview experts and novices with modified MCQs

Cycle for each IPE

Evaluation Stage

Quantitative Methods

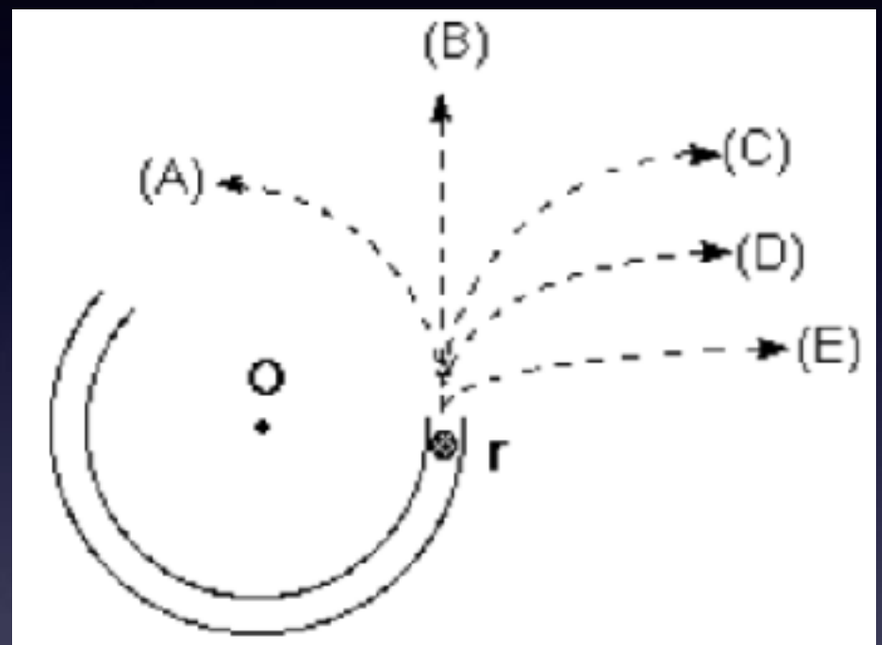
Phase 4. Evaluate items & survey

12. Use basic CTT methods to calculate item difficulty and percent discrimination
13. Apply IRT 1-parameter logistics model to estimate item difficulty & item discrimination
14. Utilize IRT results to create a shorter version of the original 23-item long survey.
15. Analyze internal consistency of short and long versions of survey

Examples of Concept Inventory Items

Force Concept Inventory

6. Which path in the figure at right would the ball most closely follow after it exits the channel at "r" and moves across the frictionless table top?

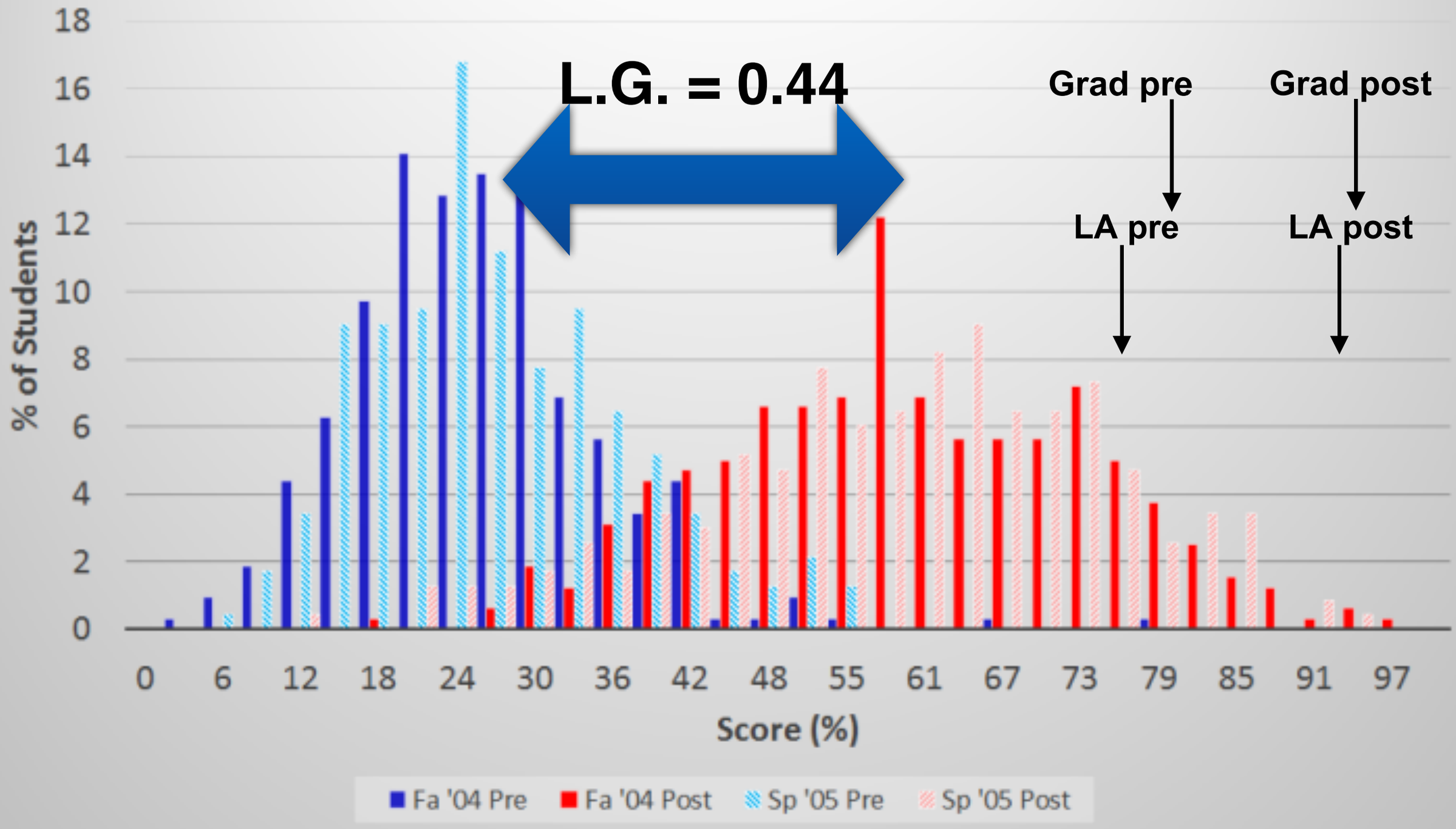


Matter and Energy (Biology)

Humans must eat and breathe in order to live and grow. Are eating and breathing related to each other? (Circle one) YES NO

If you circled “Yes” explain how eating and breathing are related. If you circled “No” then explain why they are not related. Give as many details as you can.

Electricity & Magnetism Conceptual Inventory
(F04, S05)

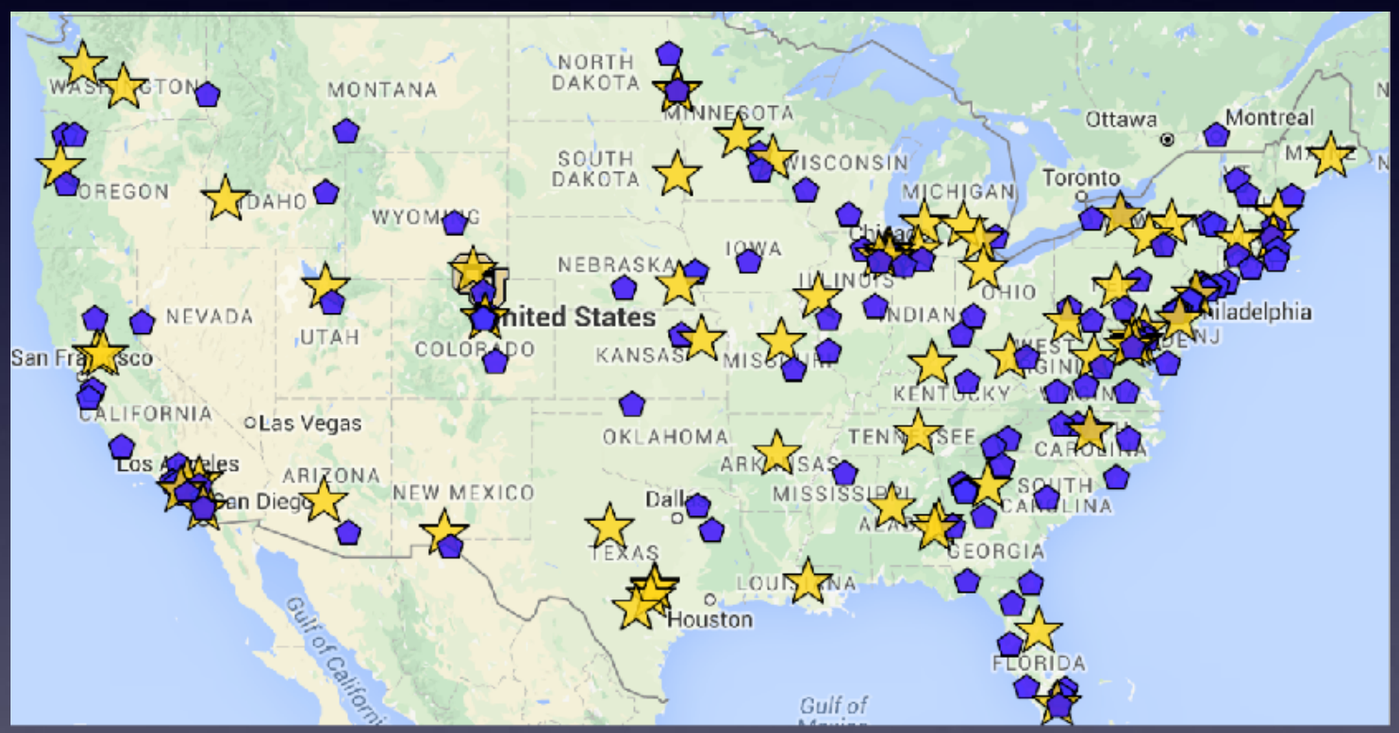


Literature Review

- 40+ publications
  - Improve learning
    - Physics (Pollock
    - Chemist
    - Math (Ne
- Close the
(Nelson
- Improv duation ra ro, In preparation)
  - +7% i yr grad rates if in >0 LA classes (n=20,642)

The Problem

- **Different learning contexts**
  - Institution type
  - Discipline
  - Student populations
  - LA uses



- **Problem for users**
  - Not enough people use Concept Inventories (CIs)
  - Additional time to administer and analyze CIs

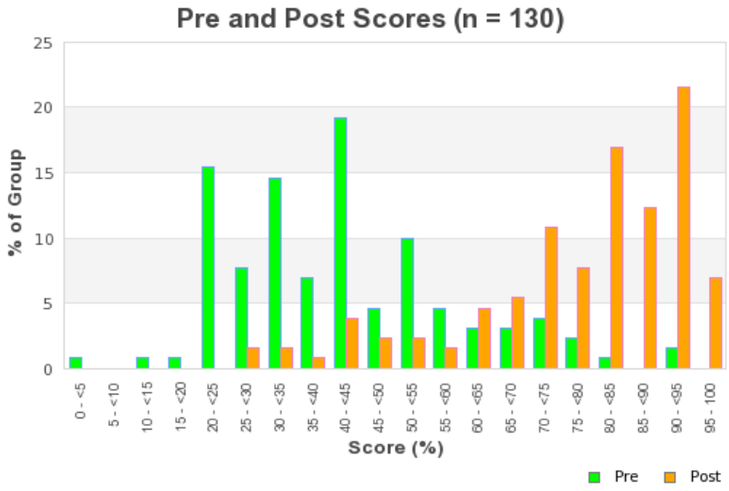
LASSO REPORT

Learning Assistant Alliance

A project of the University of Colorado-Boulder LA Model

contact@learningassistantalliance.org learningassistantalliance.org

LA Supported Student Outcomes (LASSO) Study



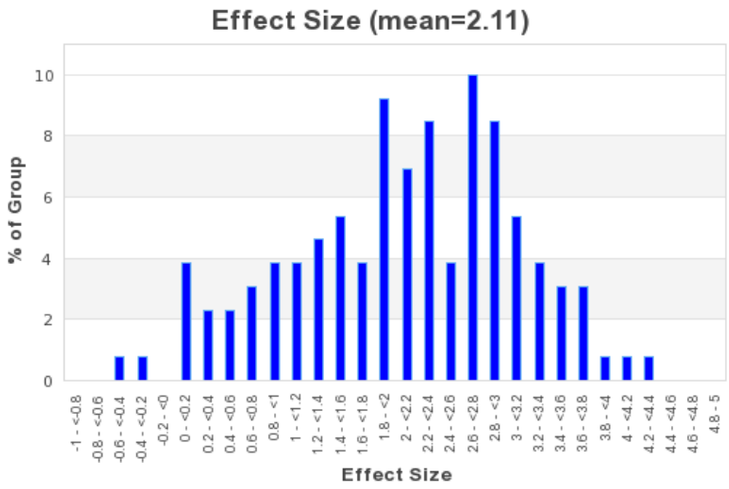
Assessment: FMCE
Institution: LASSO University
Course: ABCD 1000 - 001
Instructor: Riley Patterson
Semester: Fall 2015

Your Data

N (class) = 250
N (pre) = 190 (mean = 45%)
N (post) = 190 (mean = 75%)
N (paired) = 130
Learning Gain:
(post - pre) / (1 - pre) = 0.55

Effect size (Cohen's d) is a common statistical measure of student improvement. It measures student improvement in units of standard deviations (%post-%pre)/SD_{pooled}. To help interpret the magnitude of an effect size, Cohen provided the following guidelines [1]:

Effect Size	Cohen's d
"small"	~0.2 - 0.3
"medium"	~0.5
"large"	~0.8



N (paired) = 130
Average Effect Size: 2.11
Note: 1 score was less than -1.

For more information on interpreting this report, please view our explanatory screencast.

[1] Jacob Cohen (1988). Statistical Power Analysis for the Behavioral Sciences (second ed.). Lawrence Erlbaum Associates.

Sample Report

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Learning **A**ssistant **S**upported **S**tudent **O**utcomes (**LASSO**)

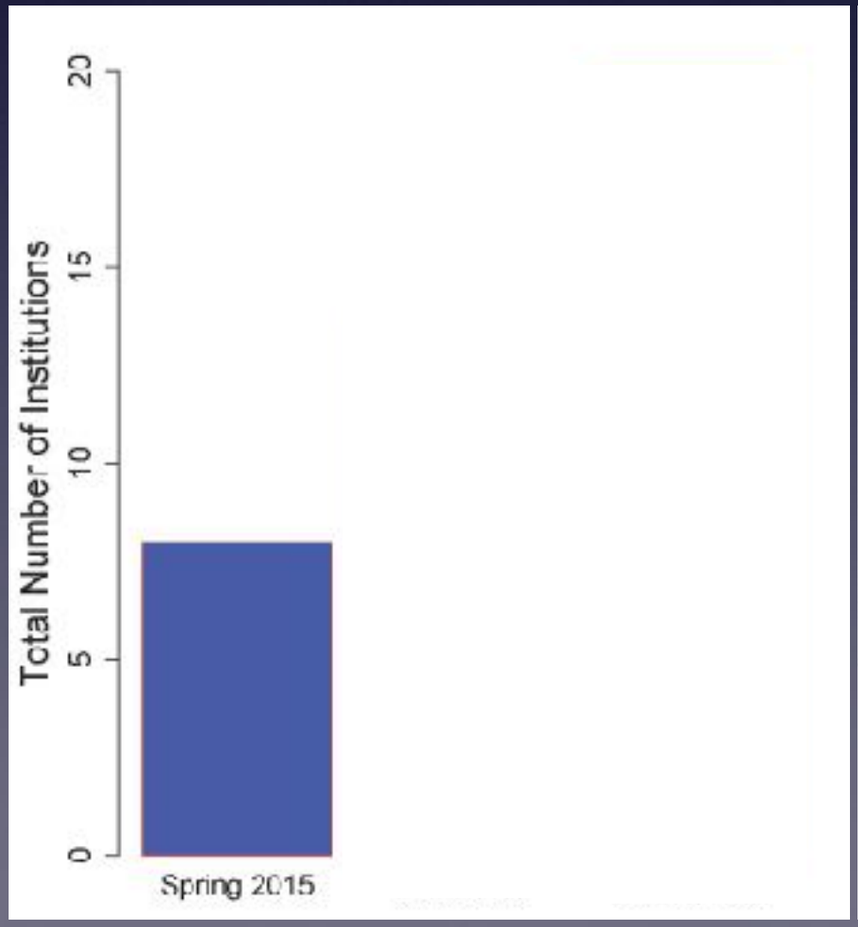
Discipline	Assessment (Fall '16)
Physics	Force and Motion Concept Evaluation (FMCE)
	Force Concept Inventory (FCI)
	Brief Electricity and Magnetism Assessment (BEMA)
	Conceptual Survey of Electricity and Magnetism (CSEM)
	Colorado Learning Attitudes about Science Survey - Physics (CLASS-PHYS)
Chemistry	Chemistry Concept Inventory (CCI)
	Colorado Learning Attitudes about Science Survey - Chemistry (CLASS-CHEM)
Biology	Concept Inventory of Natural Selection (CINS)
	Genetics Concept Assessment (GCA)
	Introductory Molecular and Cell Biology Assessment (IMCA)
	Colorado Learning Attitudes about Science Survey - Biology (CLASS-BIO)
Math	Pre-Calculus Assessment (PCA)
Astronomy	Light and Spectroscopy Concept Inventory (LSCI)

The LASSO online data collection instrument is free and easy to use!!

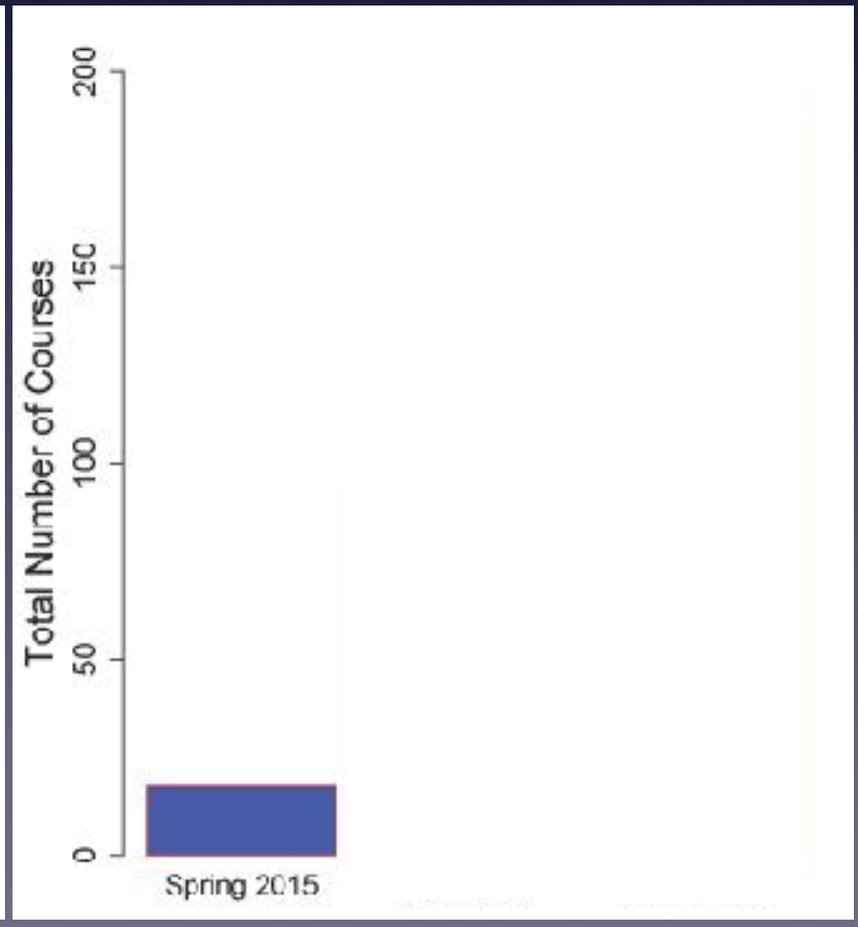
www.learningassistantalliance.org

Growth of the LASSO dataset

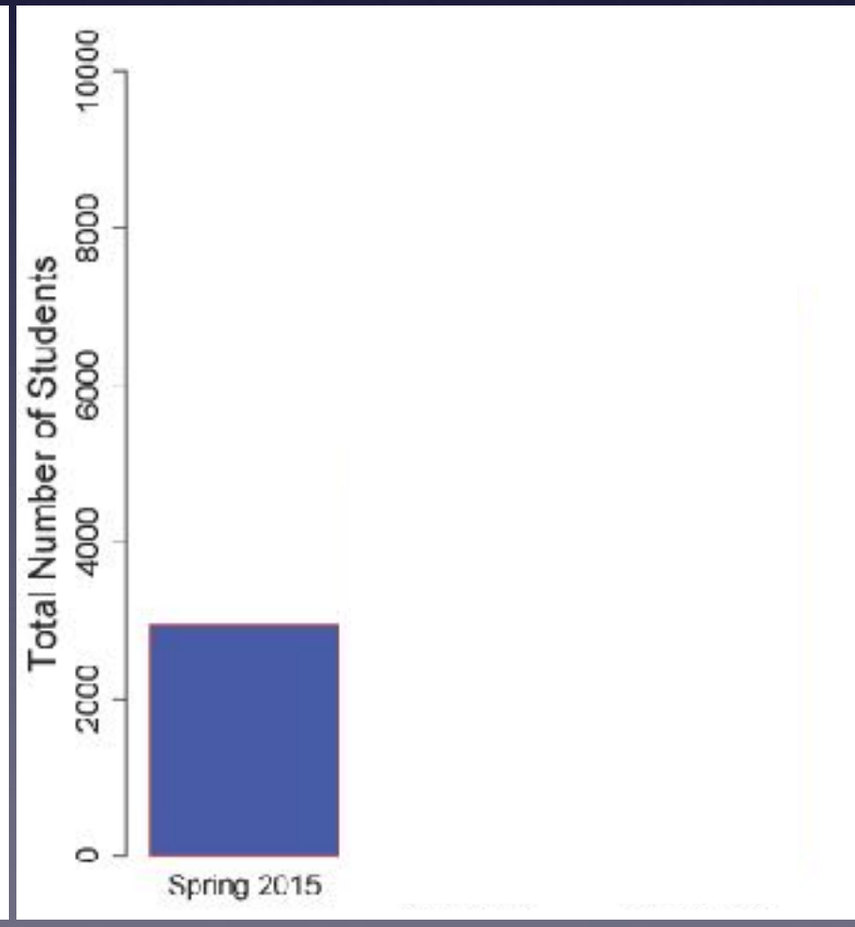
# of Institutions



# of Courses



# of Students w/ matched pre & post tests

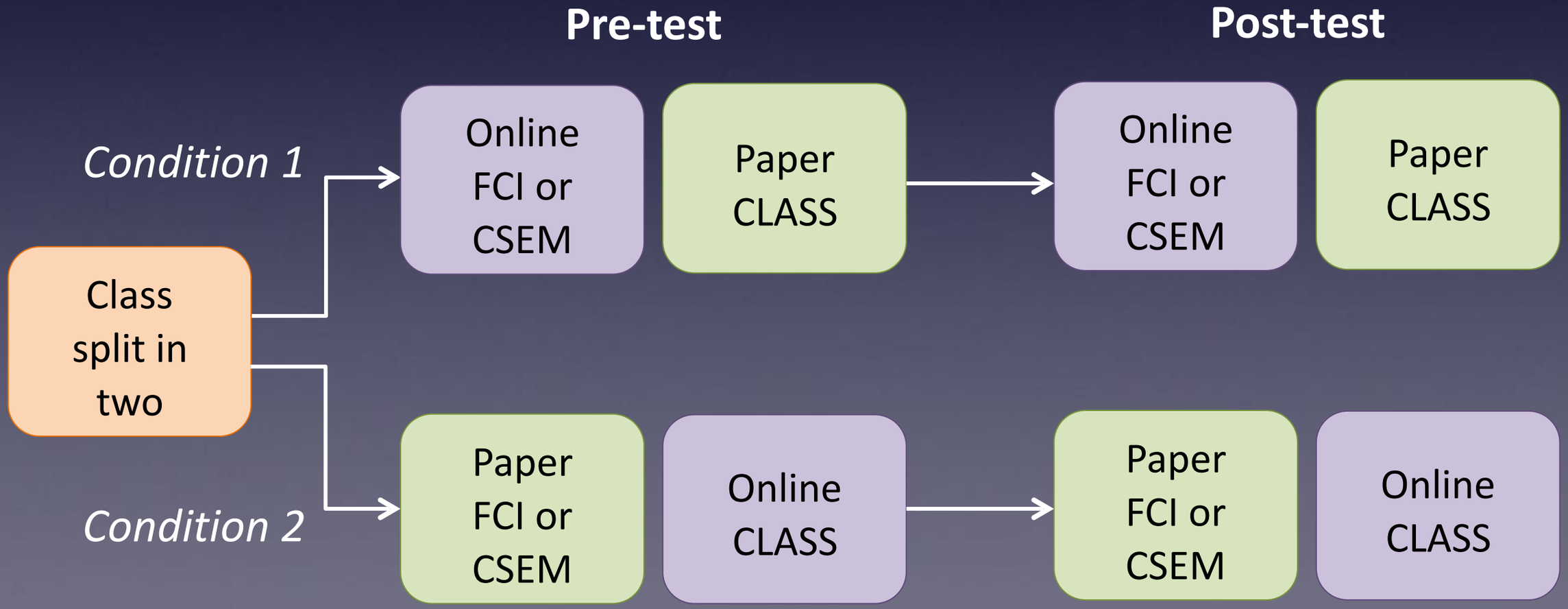


Research Questions

1. What impacts do online administrations of concept inventories have on students, if any?
2. What impacts do LAs have on student learning, if any?
3. What impacts do LAs have on classroom inequities, if any?

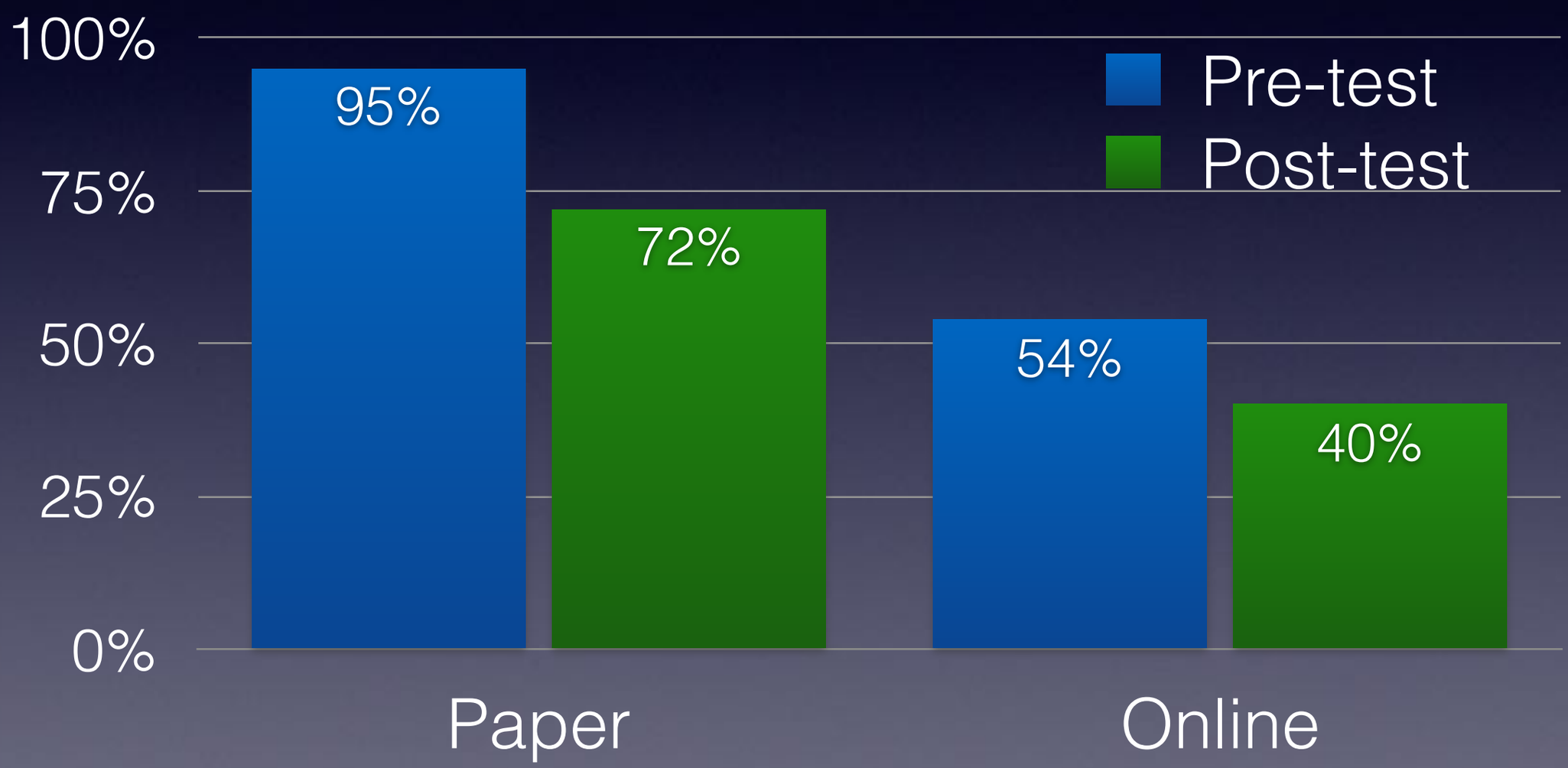
Data Analysis #1

1. 5 physics classes at large midwest university
2. Stratified random sampling into 2 conditions



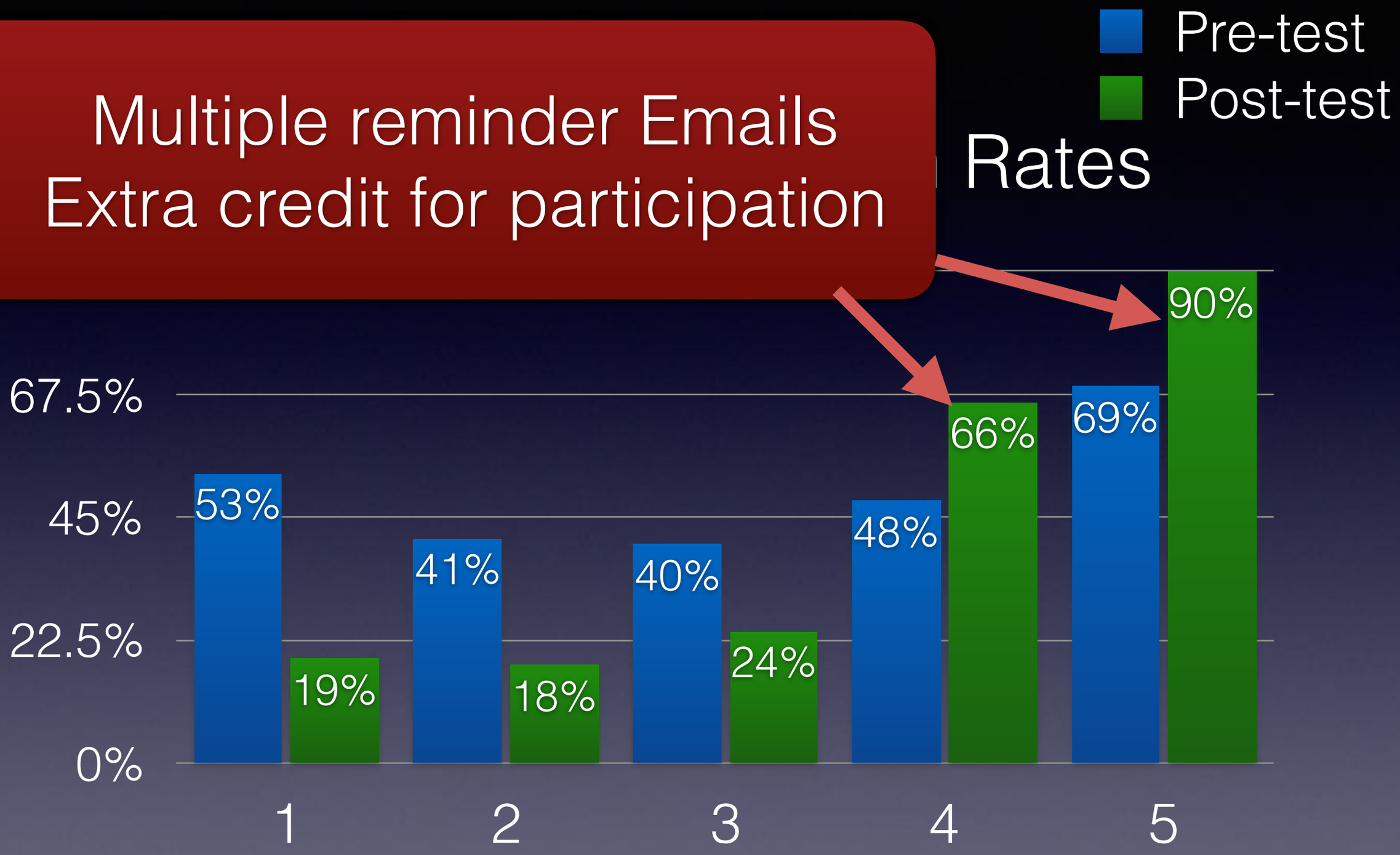
Data Analysis #1

Participation Rates



Jariwala, M., White, J.S.S, Van Dusen, B., Close, E. (in press). In-class vs. Online Administration of Concept Inventories and Attitudinal Assessments. *2016 PERC Proceedings.*

1. Multiple reminder Emails
2. Extra credit for participation



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Data Analysis #2

Physics Concept Inventories

- Pre & post scores collected at beginning and end of term.
- FCI, FMCE, CSEM, BEMA
- Calculate Cohen's d

$$d = \frac{\text{Post - Pre}}{\text{Class S.D.}_{\text{pooled}}}$$

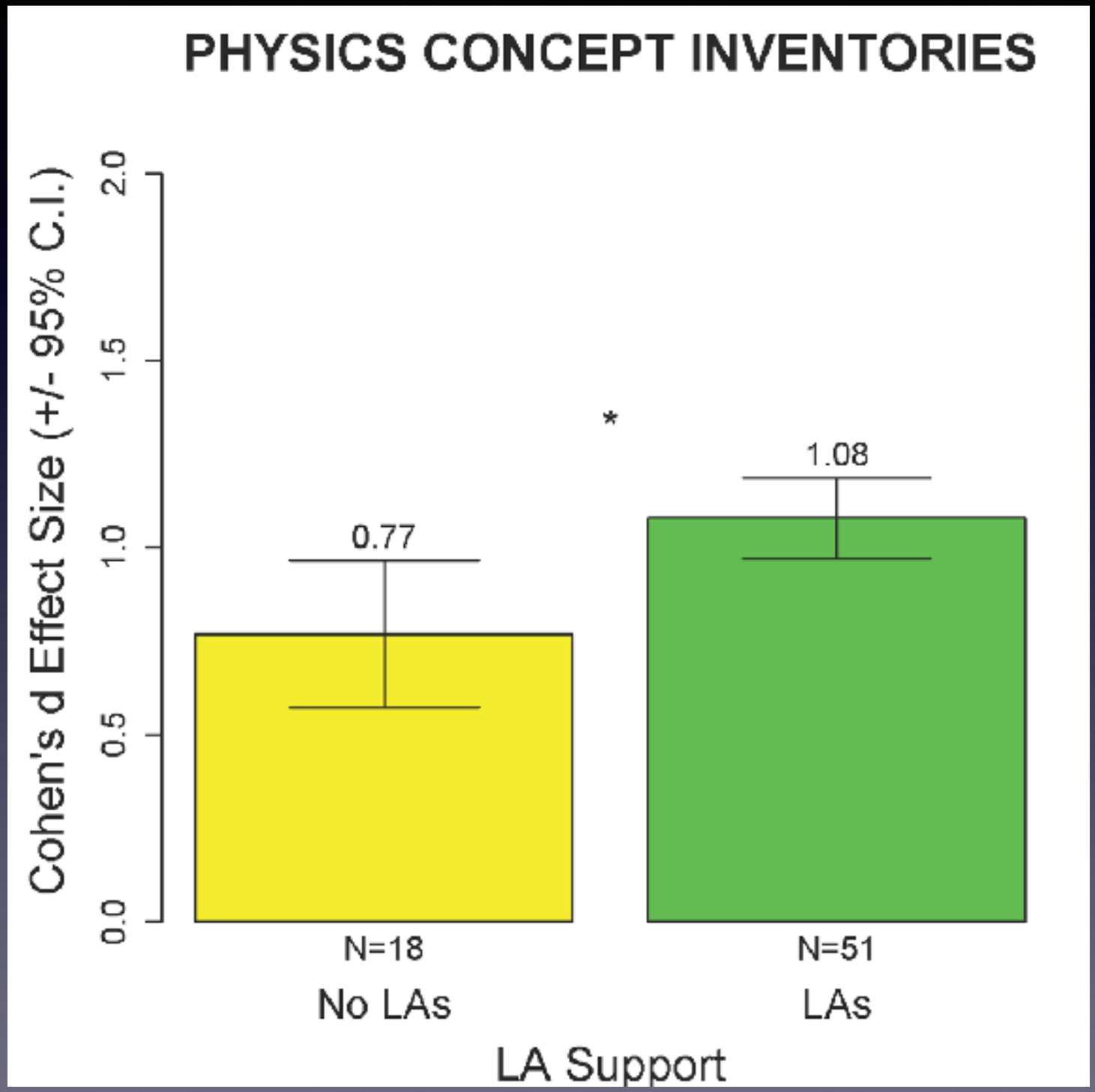
Data Cleaning

- More than 80% answered
- Paired Tests Only (Cohen's d)
- Courses with > 10 Paired Tests
- Cut scores < -1.0 and > 4.0

TABLE I. Cleaned Data Counts (LASSO).

C.I.	Institutions	Courses	Students
FCI	9	26	697
FMCE	9	15	1,592
BEMA	4	7	680
CSEM	4	21	754
TOTAL	17	69	3,753

Results: Impact of LA Support



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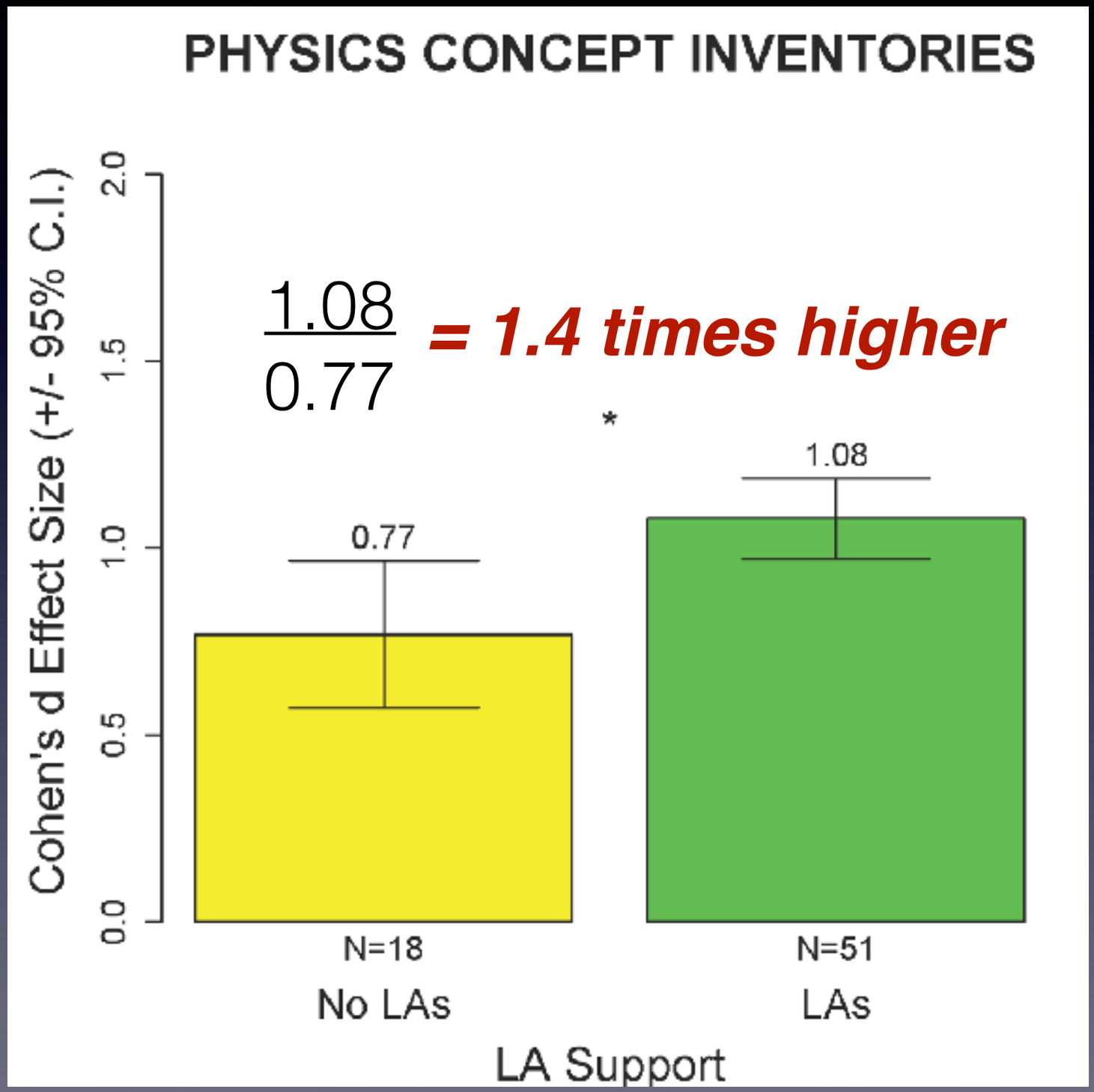

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Data Analysis #3

Data Cleaning

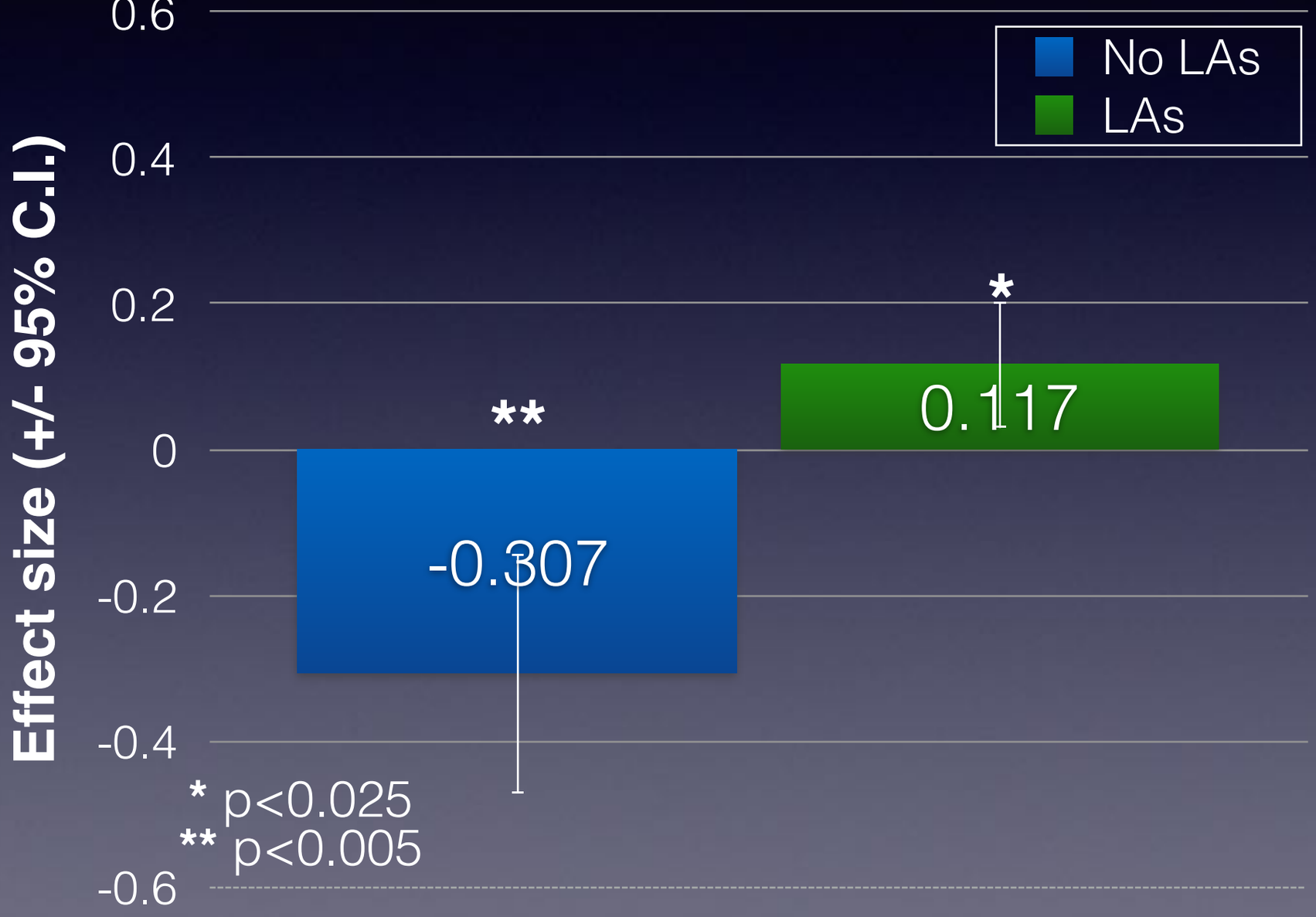
- >80% answered
- matched pre-post tests
- >10 matched sets in course
- -2<d<4

dominant = white or asian, non-hispanic, males

Instrument	Institutions	Courses	Students (%non-dom)
FCI	9	31	1,045 (41%)
FMCE	8	15	1,253 (73%)
CSEM	2	21	784 (46%)
Total	**19**	**67**	**2,982 (55%)**

Performance gap

$$\text{Gap} = d_{\text{non-dom}} - d_{\text{dominant}}$$



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Performance gap

$$\text{Gap} = d_{\text{non-dom}} - d_{\text{dominant}}$$

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Future Research

More Data!

LASSO =

(1) Free

(2) Easy to use

(3) Saves you time

(4) Awesome reports

Questions

Ben Van Dusen
bvandusen@csuchico.edu

LASSO —> www.learningassistantalliance.org

Contribution No. LAA-034, 035, & 036 of the International Learning Assistant Alliance.

DUE #1525338

Int'l LA Conference
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