

Can Courseware Designed for Equity Improve Instructor Practice?

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About Digital Promise

Digital Promise is a global nonprofit working to expand opportunity for every learner. We work with educators, researchers, technology leaders, and communities to design, investigate, and scale innovations that support learners, especially those who've been historically and systematically excluded.



*White House launch of Digital Promise,
September 2011*

Our Team



Julie Neisler



Vanessa Peters



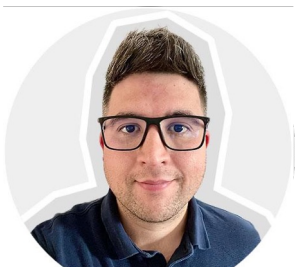
Emily Pressler



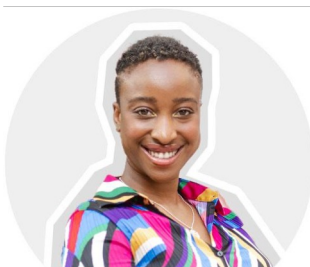
**Jonathan
Pittman**



**Michelle
Rodriguez**



**Guillermo D.
Ibarrola Recalde**



Taylor Alexander



Yoon Ha Choi



Daniel Parker

Towards a More Equitable Classroom

- Millions of students take introductory statistics, math and other gateway STEM courses every year.
- Low-income students and students of color in these courses are more likely to have:
 - Had at least two years of high school taught largely online
 - Had less access to broadband internet connections and unshared computing devices compared to their more affluent peers
 - Responsibilities outside the classroom (job, family care)
 - Experiences of mental and physical health challenges



Consequently, instructors need to pay particular attention to their learning needs and behavioral, cognitive, and affective/emotional engagement

Some Things We've Learned

- College instructors are not accustomed to adapting their practice in response to learner variability.
- When asked what they do to better serve particular historically and systemically excluded student groups, instructors often respond “I try to make my course as good as possible for all students.”
- Courseware products claim to personalize instruction, addressing needs of different kinds of learners. But that is not necessarily how they are experienced by students.
- Instructors rarely have access to, or examine, data of the engagement and learning outcomes for different kinds of students.

Course DFW Rates Are Unacceptably High

Introductory Statistics

Student Race/ Ethnicity	Low Income (Pell Eligible)	Higher Income (Not Pell Eligible)
Asian	23%	22%
Hispanic	34%	31%
White	35%	27%
Black	45%	39%

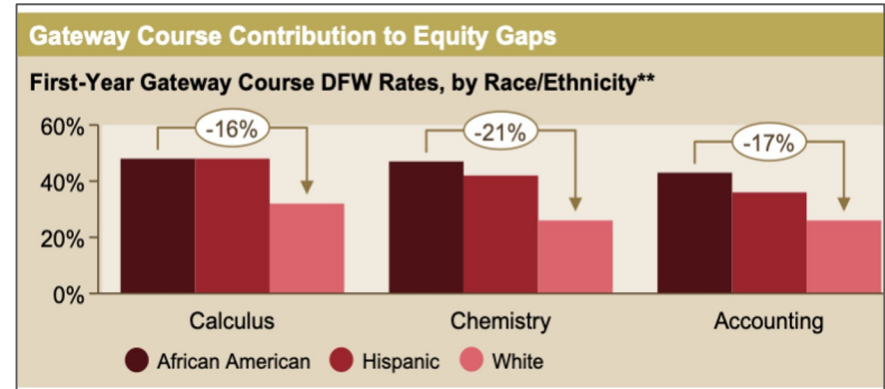
General Chemistry I

Student Race/ Ethnicity	Low Income (Pell Eligible)	Higher Income (Not Pell Eligible)
Asian	21%	21%
Hispanic	34%	30%
White	30%	26%
Black	42%	38%

Source: Analysis of 2018-2019 National Student Clearinghouse Postsecondary Data Partnership data by Digital Promise

Gates Foundation Rationale for Investing in Exemplar Courseware and Associated Research

- 20 gateway courses generate about half of all undergraduate enrollments.
- There are systemic differences in course DFW rates by race/ ethnicity and family income level.
- Available courseware products do not fully capitalize on what is known about how to support student learning.



Notes: DFW (Drop, Fail, Withdraw) rates completed from a mix of 36 different types of post-secondary institutions. Sources: National Student Clearinghouse, Pell Institute, NCAT, Gardener Institute, Tyto Partners analysis

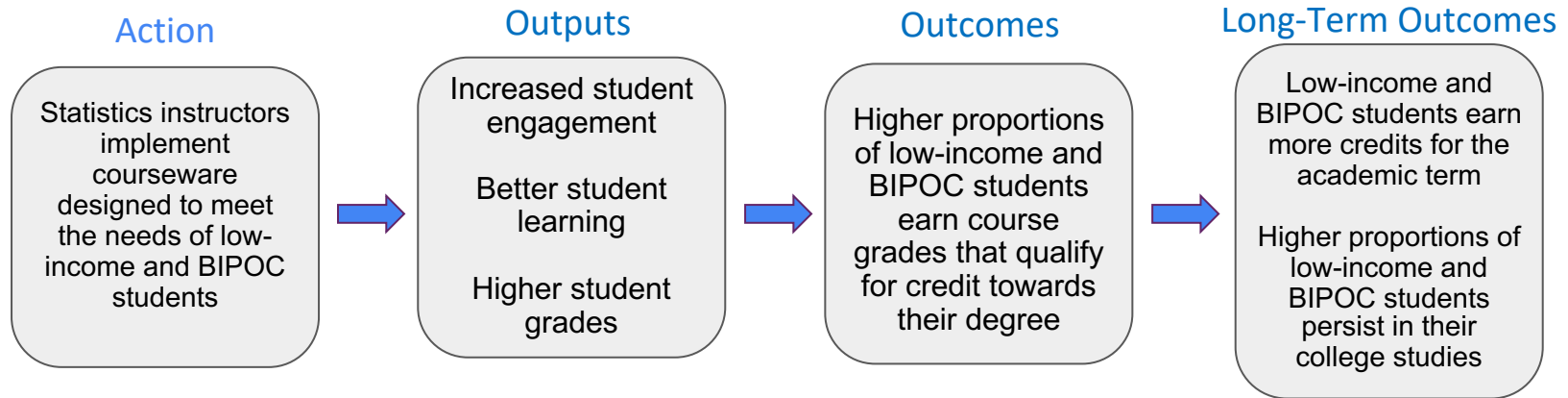
Last updated: February 1, 2022

The Foundation's Theory of Action



Current State

More than a third of Black, Latine, and low-income undergraduates enrolled in Introductory Statistics do not earn credit for the course.



Ongoing Digital Promise Research

With support from the Bill & Melinda Gates Foundation, Digital Promise is conducting research on the implementation and efficacy of two new courseware products designed explicitly to support the needs of low-income and BIPOC students:

Introduction to Statistics by Lumen Learning

The logo for Lumen Learning, featuring the word "Lumen" in a stylized, lowercase font with a yellow background, and the word "LEARNING" in a smaller, uppercase font to its right.The logo for REAL CHEM, with "REAL" in white and "CHEM" in white on a dark blue background. There are three small black circles between "REAL" and "CHEM".

Atomic foundations of the real world

REAL Chem for General Chemistry I and II by ASU+CMU

These exemplar products are intended to address needs of historically and systemically marginalized learners both

- directly, through their content and practice opportunities, and
- indirectly, by giving faculty data and tools that encourage and support [evidence-based teaching practices](#).

Evidence-Based Teaching Practices

- Active Learning
- Collaborative Active Learning
- Formative Assessment
- Fostering a Sense of Belonging through an Inclusive Learning Environment
- Data-Informed Instruction
- Support for Metacognition and Self-Regulated Learning
- Instructional Transparency



Our Statistics Research



We're conducting a multi-year project to study statistics teaching practices and courseware that advance racial and socioeconomic equity, particularly prioritizing low-income students and those who identify as Black or Latine.

Our first cohort of participating statistics faculty, drawn from across the country, is helping us investigate the student outcomes associated with different ways of implementing the new courseware from Lumen Learning.

Our next cohort of faculty partners will help us determine whether the new courseware achieves its goals for student outcomes.

Lumen One Introduction to Statistics Courseware



Designed explicitly for course equity

Lumen One Courseware Supports for EBT Practices

Active learning and practice with feedback

Sense of belonging, collaborative learning, and metacognition

Use of data to inform instruction

Learn It



Videos, readings and practice questions to help you understand the core concepts in this topic.

Apply It



Practice questions and videos to build on what you've learned and bring key concepts together.

Self Check



Answer these questions to check how you're doing. Take it as many times as you need.

Choose Your Own Dataset

Choose Your Own Dataset

For this problem, you'll create a frequency table and bar graph or pie chart using a dataset of your choosing.

Choose a Dataset

- Who Owns the Business?
- Reservation Household Size
- Scammer Alert

Show

Statistical Tool

Use the [Describing and Exploring Categorical Data tool](#)

Follow these steps:

STEP 1: Select the "Two Categorical Variables" tab.

STEP 2: Locate the dropdown under "Enter Data and select "Contingency Table".

STEP 3: For a Stacked Bar Chart, scroll down to "Options for Barchart" and select the "Stacked Barchart" option.



Lumen One Courseware Supports for EBT Practices

Active learning and practice with feedback

Sense of belonging, collaborative learning and metacognition

Use of data to inform instruction

Home
Assignments
Discussions
Grades
People
Syllabus
Modules
BigBlueButton
Collaborations
Badges

See Example

See the Example Question

Evaluate Distributions of Quantitative Variables

Select Instructor: Dr. Pamela E. Harris

3.5 Evaluate distributions of quantitative variables w/ Dr. Pamela E. Harris

Introductory Statistics

Dr. Pamela E. Harris

3.5 Evaluate distributions of quantitative variables

Dr. Pamela E. Harris

ling Techniques and Explain Bias in Sampling

Dr. Lane Fisher

2.2 Conduct different sampling techniques and explain bias

Dr. Aris Winger

Watch on YouTube in sampling



Stuff Not Making Sense?

Other students might be wondering about the same things as you. Visit the Lumen Community to ask questions, give answers, or share ideas.

Visit Lumen Community

Lumen One Courseware Supports for EBT Practices

Active learning and practice with feedback

Sense of belonging, collaborative learning, and metacognition

Use of data to inform instruction

The screenshot displays two main sections of the Lumen One Courseware interface. The top section, titled "Time Sensitive Interventions", features a "What's This?" tooltip and a "View 26 Interventions" link. It highlights a student named Vic (Elijah Victorious Clark Jr.) with a 33% participation rate in self-checks and a 58% low score on the first quiz. A message states, "You can make a difference by reaching out to Vic," with buttons for "Email Student" and "Dismiss Intervention". Below this, a list of topics Vic is struggling with includes: "Means and Medians as Measures of Center", "Measures of Variability", "The Influence of Outliers on Measures of Center", and "Boxplot Data and Displays".

The bottom section, titled "Automated Messages", shows a "What's T" tooltip and a "6 Nice Work" notification for emails sent. A toggle switch indicates "Automated Messages are ON". To the right, a "Help Gabe Garcia" section shows a "Gabe missed questions on 2 Outcomes" notification with an "Expand" link. It includes tabs for "Office Hours Invitation" and "Supplemental Help". The message body contains a "From:" field with "Michelle Conroy", a "Subject:" field with "Can I help you?", and a "Body:" field with a rich text editor. The message text reads: "Hi Gabe, it looks like you might be struggling with some of the ideas we're covering in class. Specifically, it looks like you're struggling with the following topics: - Calculate a test statistic and interpret its value in context - Use a test statistic to decide whether the null hypothesis about a population proportion is a plausible explanation for sample results. Would it help if we took a few minutes to talk through these? I'd be happy to meet with you during office hours, on the phone, over Skype, or in whatever way works best for you. I'm confident that if we talk through these issues, you can get quickly up to speed and get back to succeeding in the course. I know you can do it!" A "Send Message" button is located at the bottom right.

Our Chemistry Research



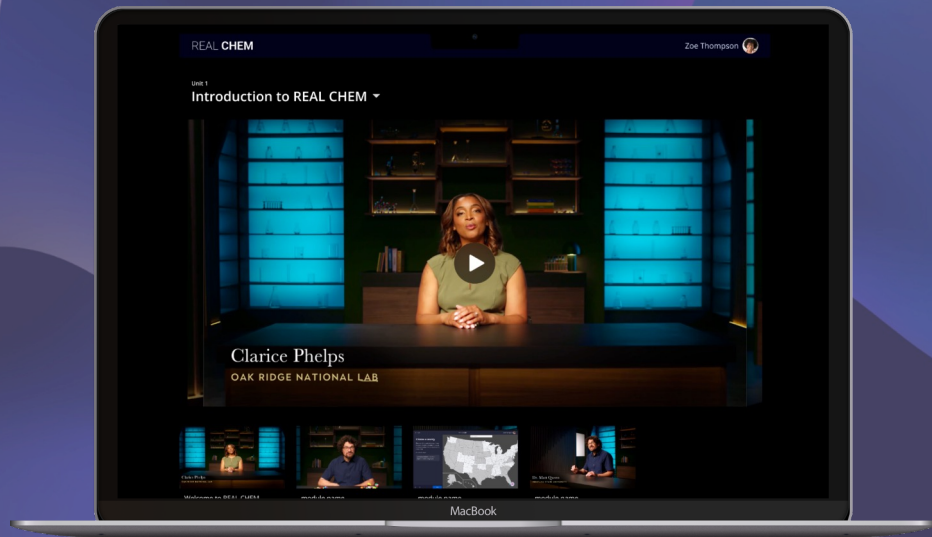
This project will examine implementation of REAL CHEM courseware that emphasizes the relevance of chemistry to students' lives and chemistry as a process of exploration and investigation.

We are working with chemistry faculty to understand teaching and learning in Gen Chem I and how instructional practices and student outcomes do or do not change when the REAL CHEM courseware developed by ASU and CMU is integrated into the course.

REALCHEM

Relevant, Engaging, Active Learning

*Enabling equitable success by helping students see the **relevance** of what they are learning, while supporting them in ways that are **responsive** to their needs and desires.*



Blended Learning Pre-class: The Foundation



The **Foundation** material conveys core concepts, motivating and engaging with best-in-class content, video, and a variety of rich activities that provide thoughtful scaffolding and targeted, adaptive, formative feedback. Students are prepared for more collaborative, focused learning in the classroom.

Interactive and engaging media spark and sustain motivation.

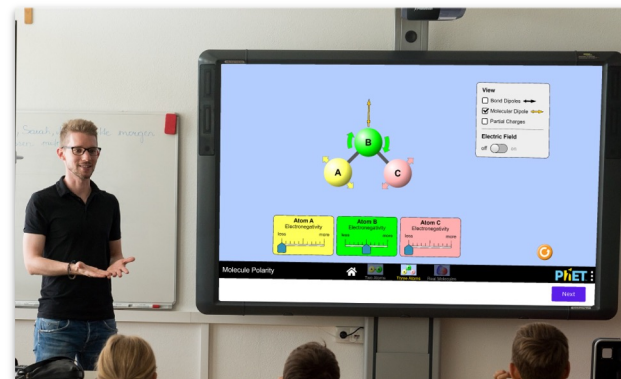
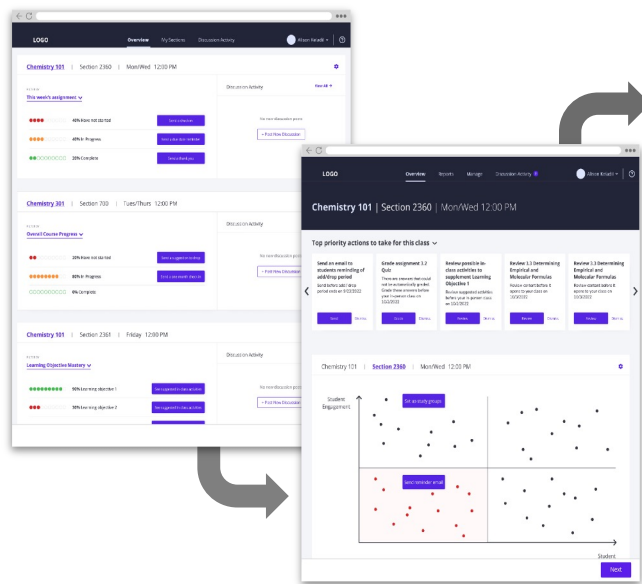
An embedded system for discussion, annotation, and collaboration fosters peer-learning.

Learn-by-doing activities provide detailed guiding feedback, scaffolded to support difficult concepts.

R.E.A.L. Chemistry Blended Learning In-Class: Focused Instruction



Class activities concentrate on areas in which students are struggling. Instructors are provided **Focus** activities that help instructors shift from lecture to student-centered active learning, guided by detailed information about student participation and progress in pre-class activities.



Instructors are given carefully curated in-class activities, including OER resources. Guidance from DEI experts and experienced instructors helps ensure inclusive and effective classroom integration.

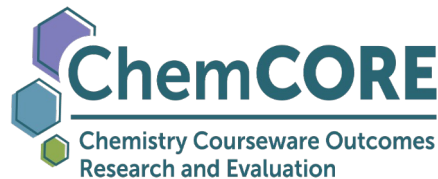
Analytics and embedded professional development guide classroom practice.

Questions Addressed in Our Research



Key Research Questions

- What is the impact of Lumen One Statistics courseware on student engagement, learning and achievement, particularly for Black, Latine, and low-income students?
- Does this equity-focused courseware with embedded instructional supports lead to greater use of *evidence-based teaching practices* (such as active learning)? And if so, how?



Key Research Questions

- What are the experiences of faculty and students (especially Black, Latine and low-income students) while using the courseware?
- What conditions and characteristics are associated with differences in how faculty and students use the courseware? (e.g., type of institution, instructional context, professional learning resources, instructor profile, student background)

Evidence-Based Teaching Practices

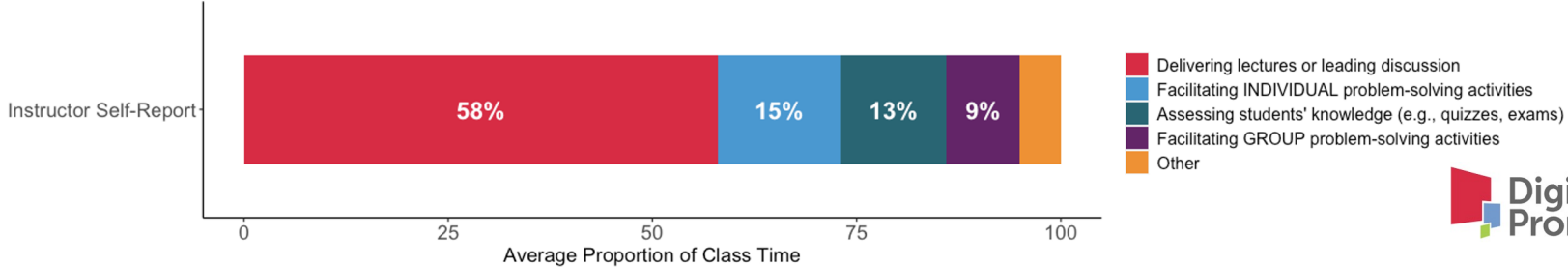
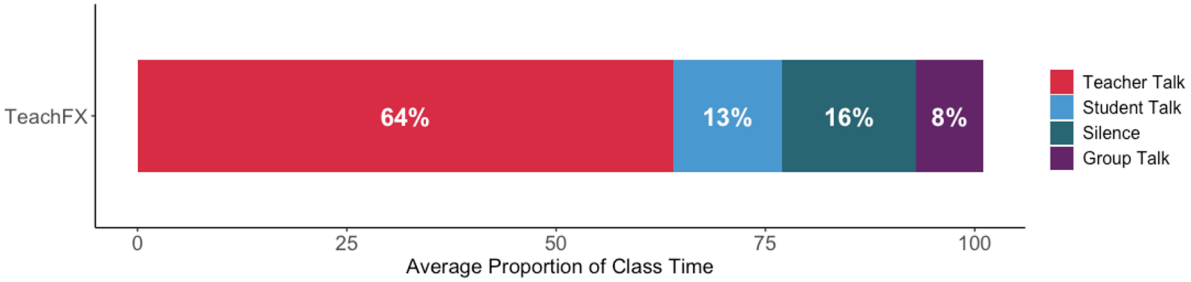
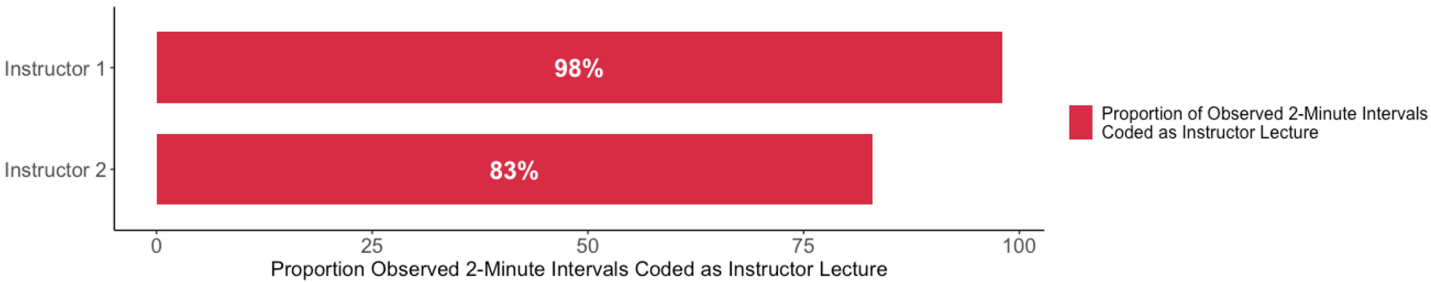
- Active Learning
- Collaborative Active Learning
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- Building on Prior Knowledge
- Support for Metacognition and Self-Regulated Learning
- Data-Informed Instruction
- Instructional Transparency



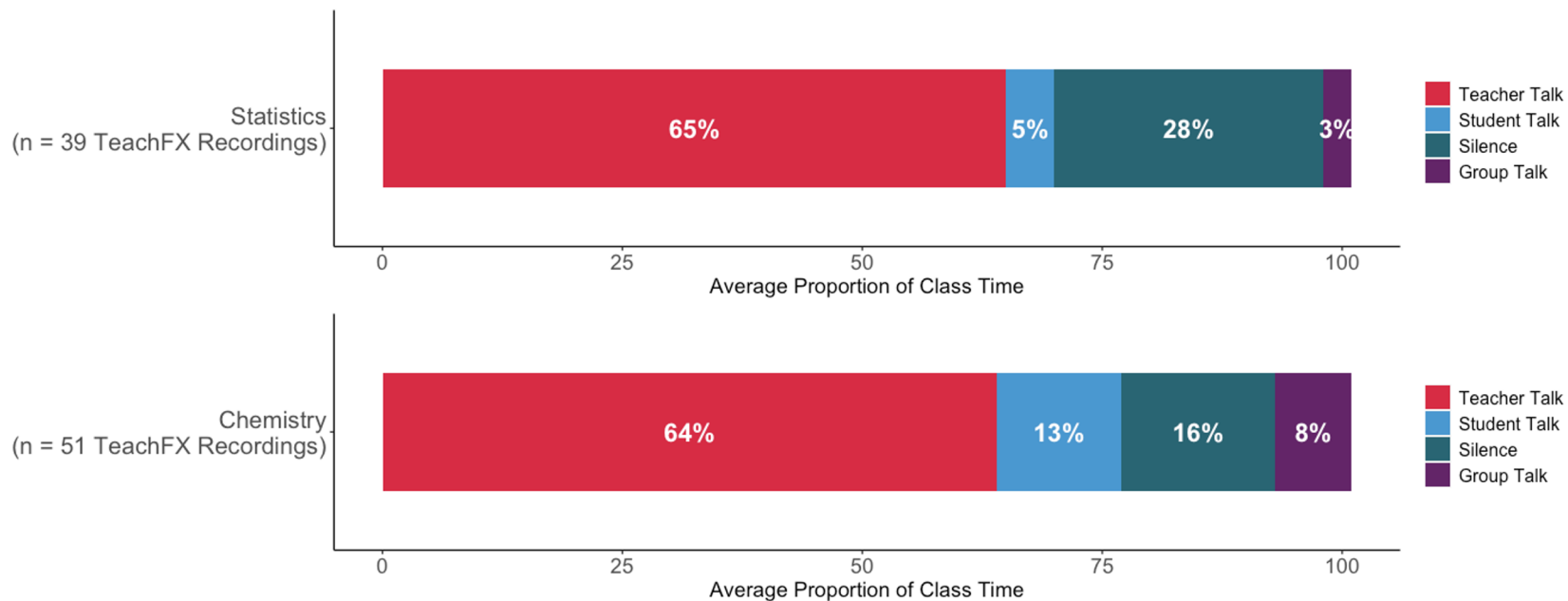
Research on the Impact of Practices Encouraging Active Learning

- Freeman et al. (2014) meta-analysis of 158 studies found that compared to classes taught in lecture format, **classes using more active forms of instruction resulted in higher examination scores by an average of 6 percentile points** (effect size of +0.47).
- Across 68 studies, Freeman et al. found that **students in classes with traditional lecturing were 1.5 times more likely to fail** than those in classes with more active forms of instruction.
- Meta-analytic work by Theobald et al. (2020) found that **active learning (non-lecture) practices narrowed differences between minoritized groups and non-minoritized groups** in terms of STEM course examination scores by 33% and narrowed differences in STEM course passing rates by 45%.

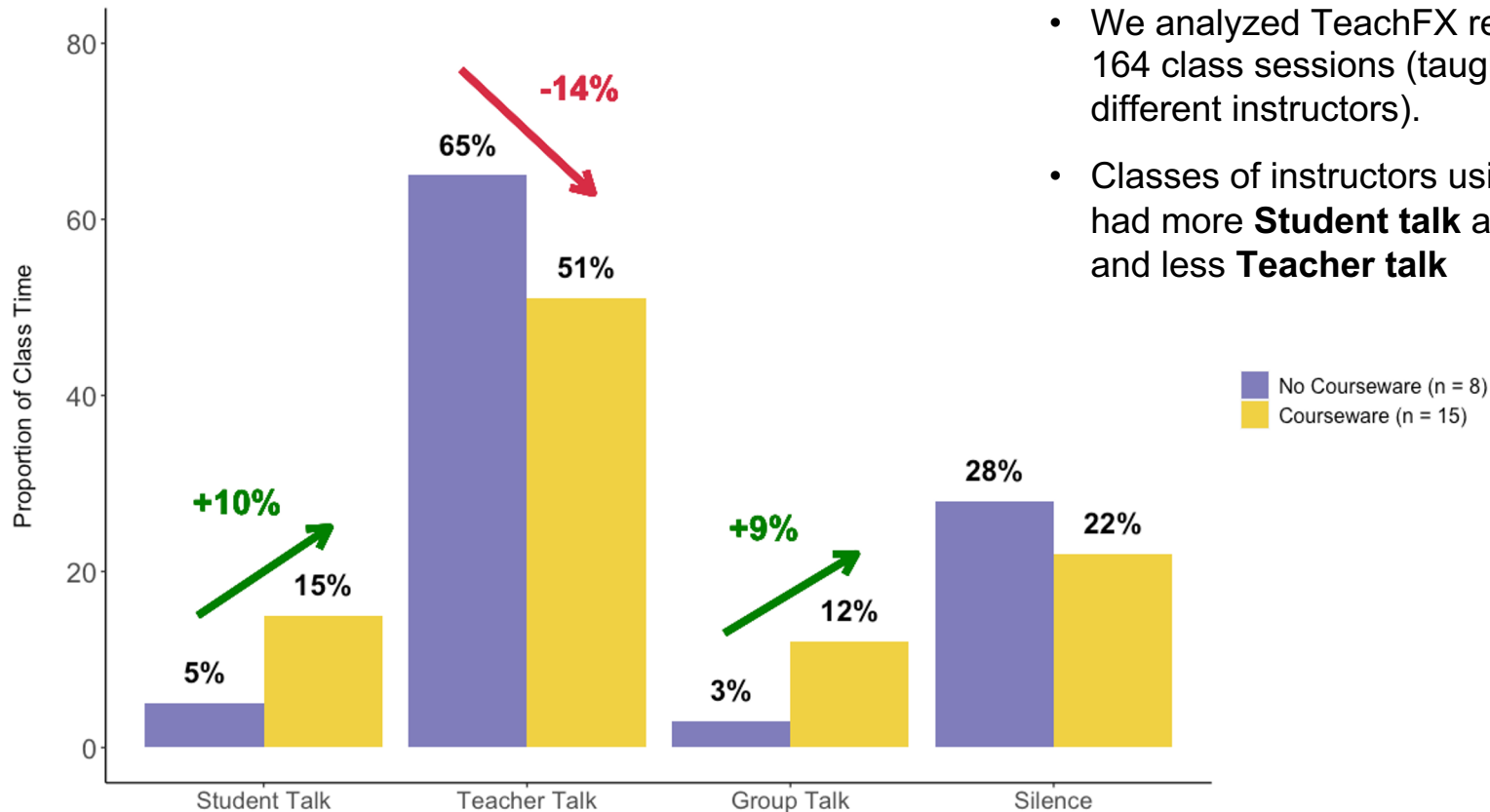
We Measured Proportion of Class Time Teacher Spends Talking as Proxy for Lecture (Non-Active) Learning



Proportion of Class Time Teacher Spends Talking in Courses Without Courseware Appears to Be Nearly Two-Thirds



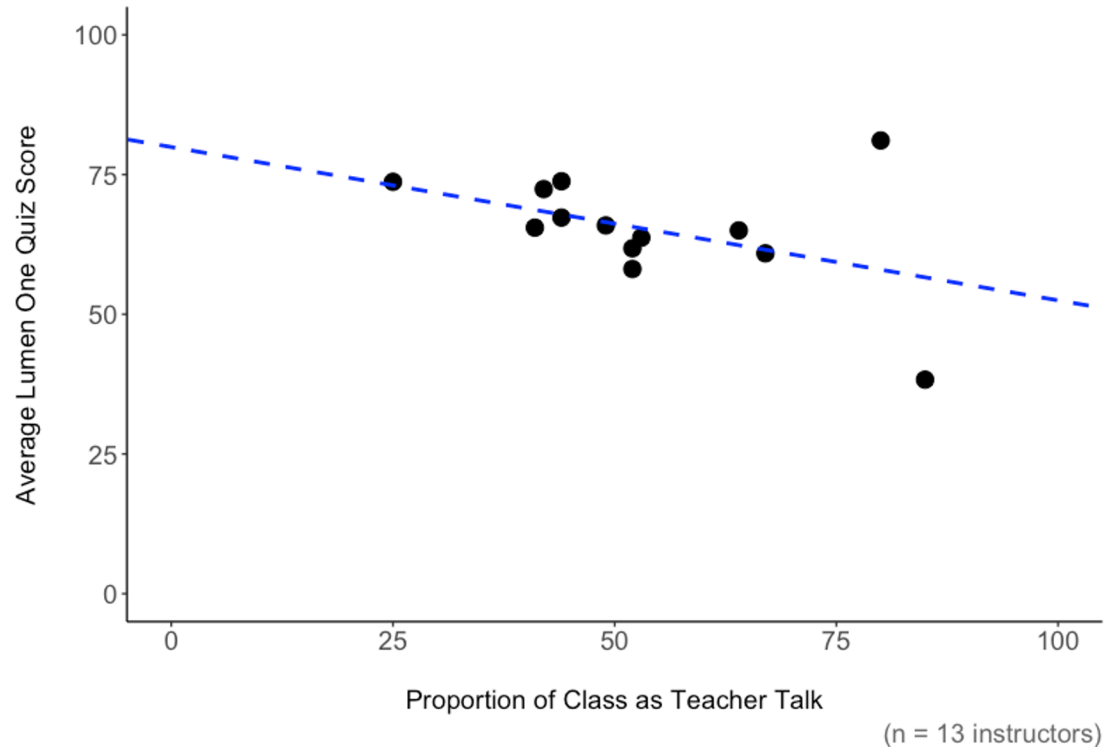
Teacher Talk Time is Lower in Courseware-Using Classes



- We analyzed TeachFX recordings for 164 class sessions (taught by 23 different instructors).
- Classes of instructors using courseware had more **Student talk** and **Group talk** and less **Teacher talk**

Relationship Between Teacher Time Talking and Student Learning

- The average proportion of Teacher Talk time was calculated for each instructor, with percentages ranging from 23% to 85%.
- The average student score on courseware quizzes was computed for each instructor's class (average number of quizzes completed ranged from ~5 to ~12).
- The relationship between proportion of Teacher Talk and student learning is moderately strong ($r = -0.44$) for these 13 statistics instructors.



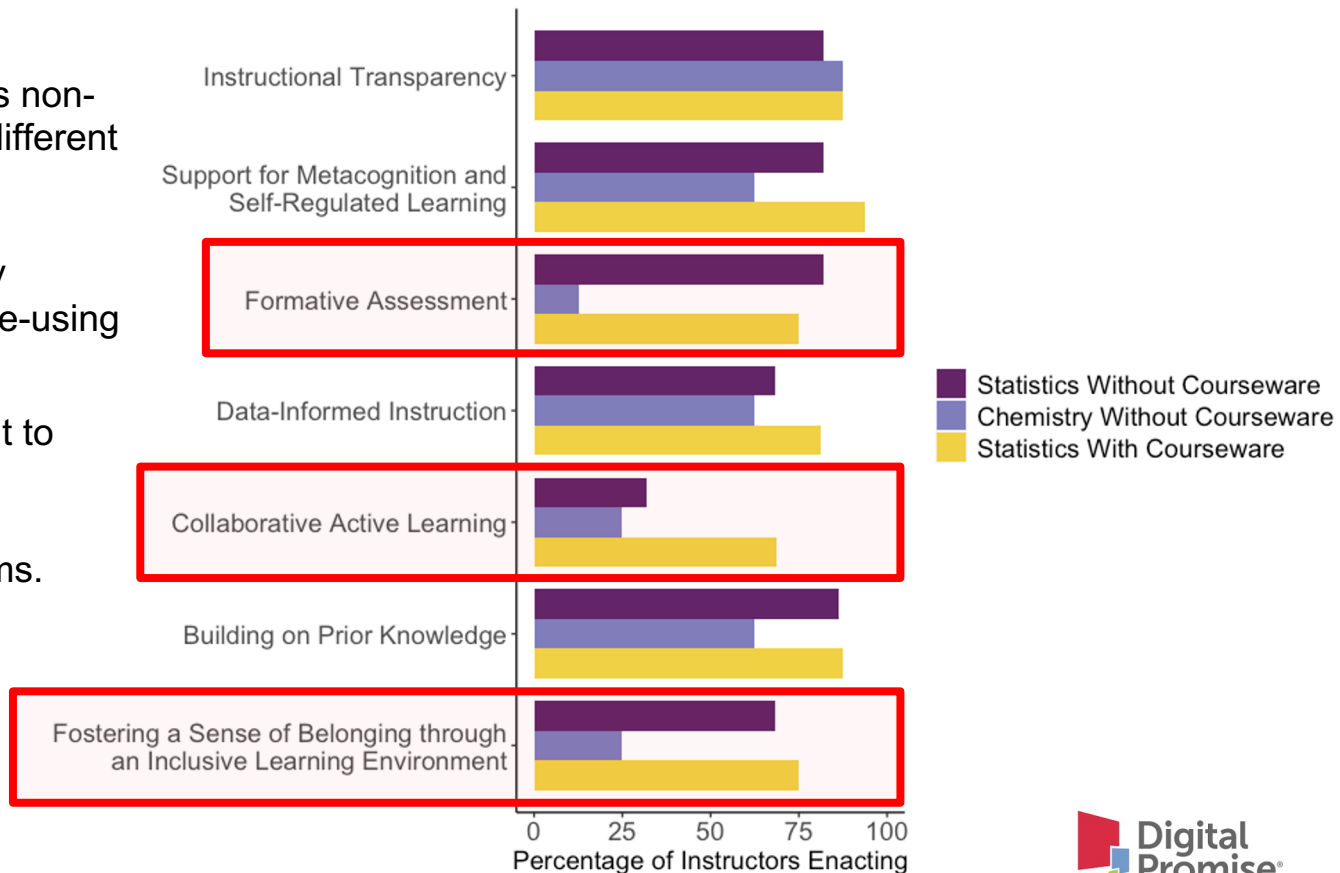
Three instructors were removed from the analytic sample; one was in an online asynchronous class with no Teacher Talk time and two had an average of 1 or fewer quiz scores in the platform.

Student Reports of Other Evidence-Based Teaching Practices

	Statistics - Business as Usual	Chemistry - Business as Usual	Statistics - With Courseware
Fostering a Sense of Belonging through an Inclusive Learning Environment	68%	25%	75%
Building on Prior Knowledge	86%	63%	88%
Collaborative Active Learning	32%	25%	69%
Data-Informed Instruction	68%	63%	81%
Formative Assessment	82%	13%	75%
Support for Metacognition and Self- Regulated Learning	82%	63%	94%
Instructional Transparency	82%	88%	88%

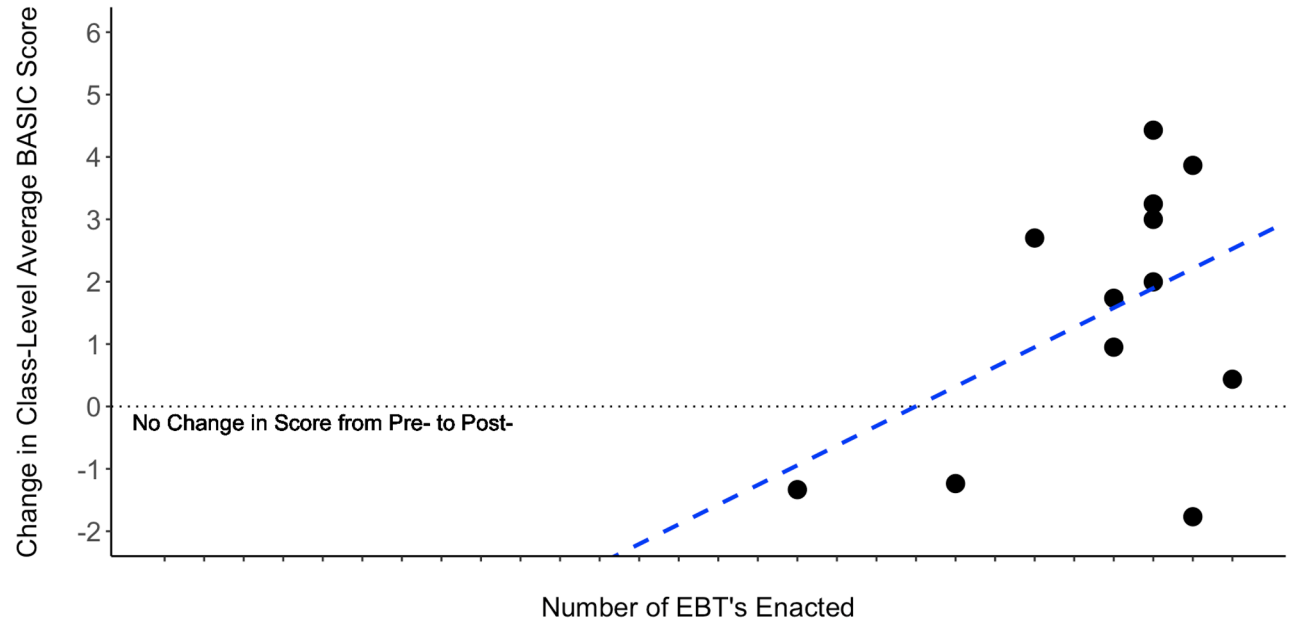
Student Reports of Other Evidence-Based Teaching Practices

- The majority of the Statistics non-CW instructors came from different semesters and different institutions. They and their students are not necessarily equivalent to the courseware-using instructors and students.
- However, these results point to important trends between courseware-using and non-courseware using classrooms.



Relationship Between Evidence-Based Teaching Practices and Student Learning in Courseware-Using Classes

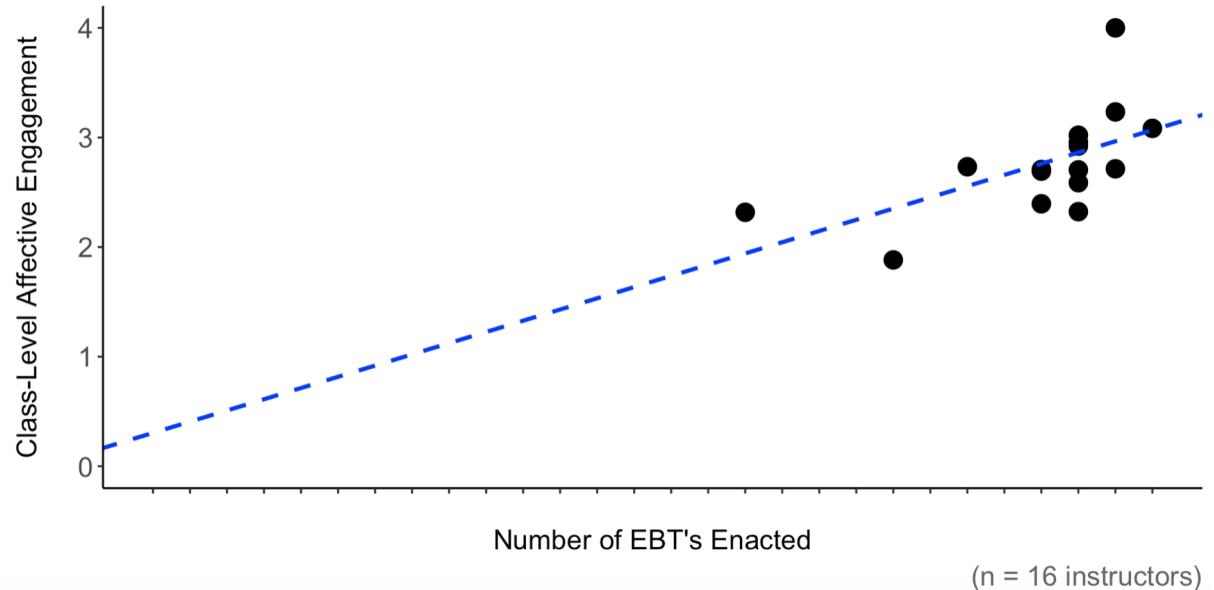
- Instructors enacted between 16 and 27 of the 27 EBT components measured on the student survey.
- Students in 12 classes took an assessment of conceptual knowledge at the start and the end of the course. Average student gain score was calculated for each instructor.
- The relationship between EBT practice use and change in Conceptual Understanding is moderately strong ($r = 0.46$) for these instructors.



(n = 12 instructors)

Relationship Between Evidence-Based Teaching Practices and Student Learning in Courseware-Using Classes

- Instructors enacted between 16 and 27 of the 27 EBT components measured on the student survey.
- Students completed a 9-item measure on affective engagement. Averages for each instructor were then calculated.
- The relationship between EBT practice use and student Affective Engagement is moderately strong ($r = 0.59$) for these 19 statistics instructors.

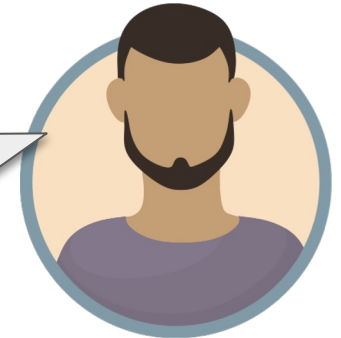


Student Responses to the Courseware



Now that ... we're more than halfway into the course, **I don't really doubt myself [any more]** ... I think I find it very interesting, which makes it easier for me to learn, when I find something interesting about it.

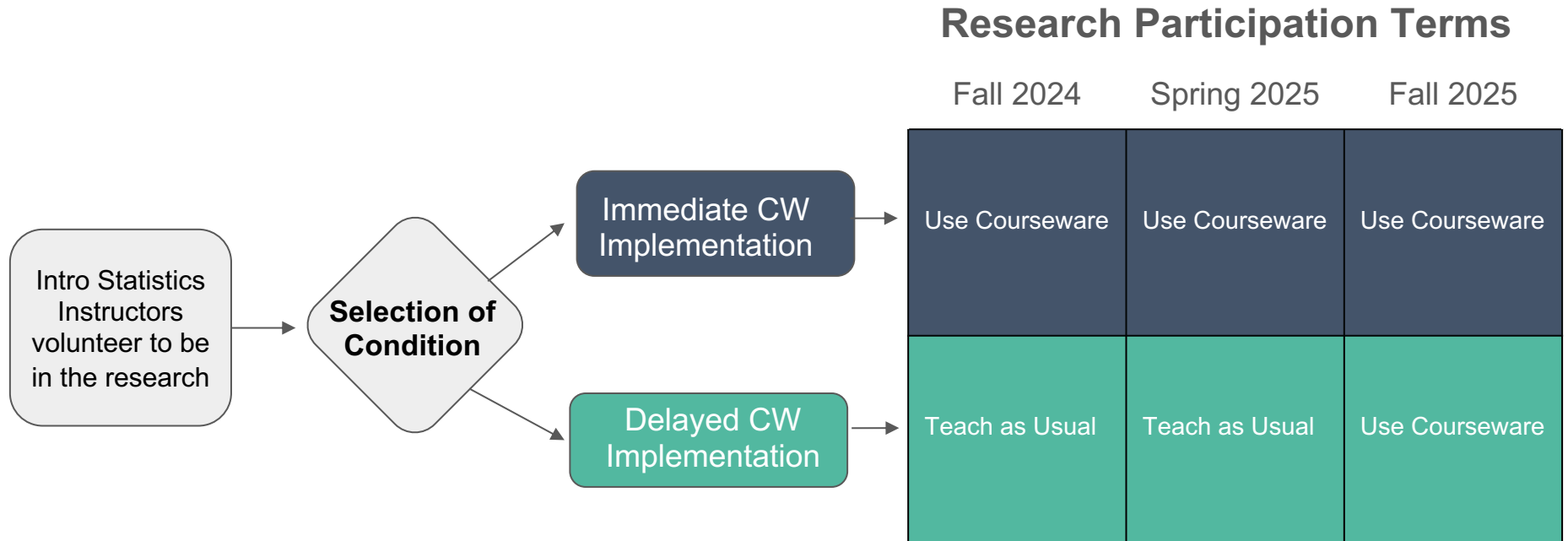
... they use real life examples. That makes sense too. It helps give me an idea on where I can apply statistics, like, I never thought I can apply statistics to animal adoptions and breed size.



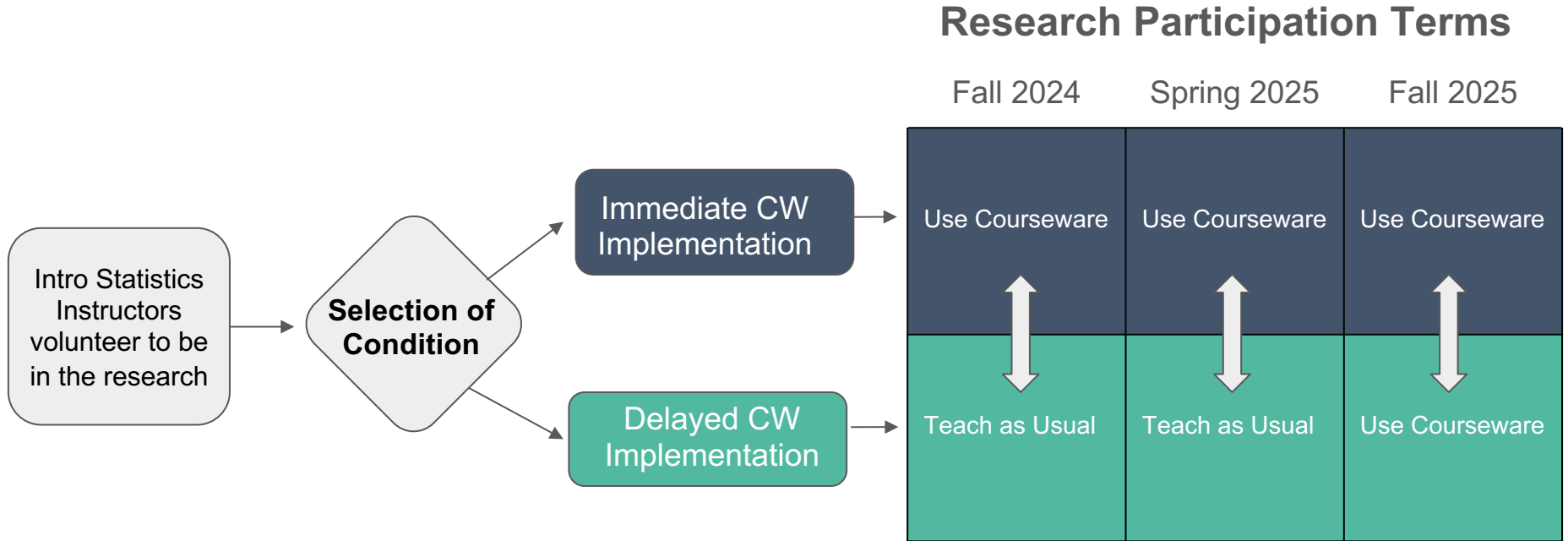
Still to Learn

- Does implementing exemplar courseware along with evidence-based teaching practices lead to significant benefits for low-income, Black, and Latine students? In terms of:
 - Affective engagement (Liking, Valuing, Expectation of Success)
 - Behavioral engagement (attending class, doing readings,
 - Learning
 - Course grade
- What instructor practices provide the most value in terms of enhancing these outcomes?

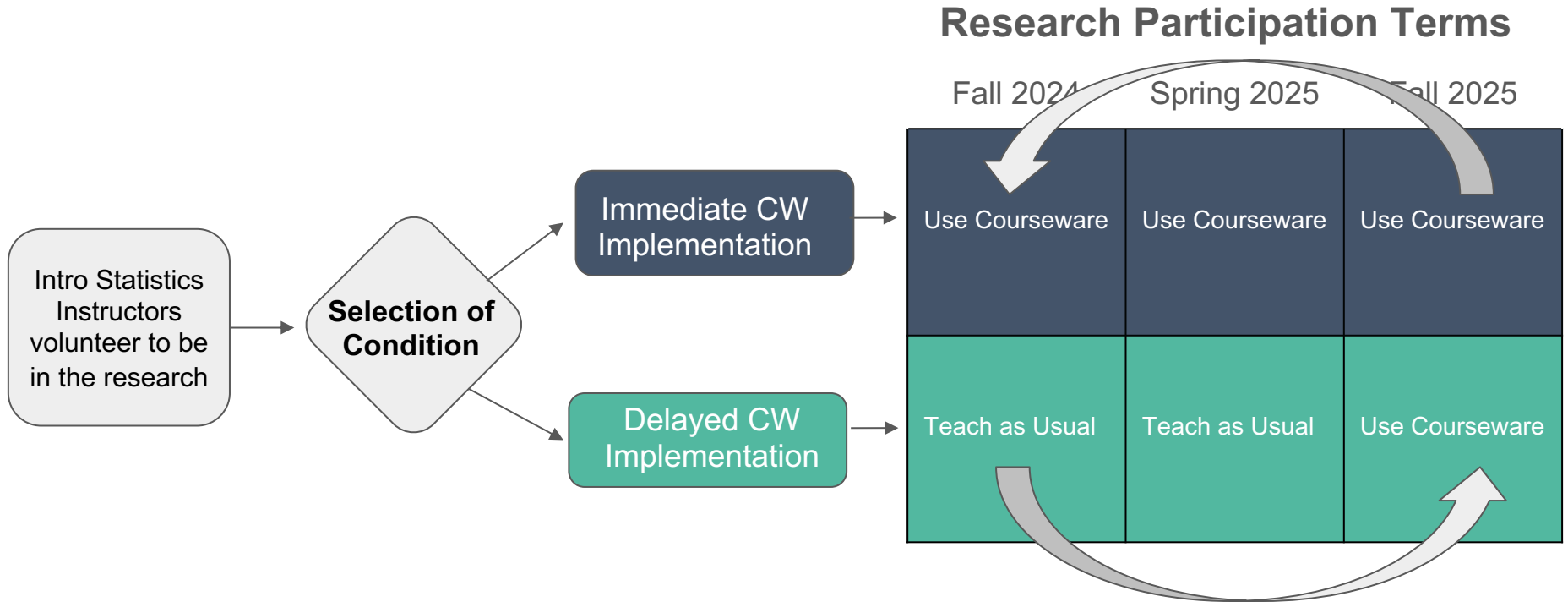
Research Design



Research Design



Research Design



Interested in Trying Out These Courseware-Supported Practices in Your Courses?



STATS Statistics Teaching
and Technology Studies

Email

epressler@digitalpromise.org

Follow QR Code





REAL Chem Demo Videos
from ASU/CMU



Research Participation
Interest Form



Email guillermo@digitalpromise.org