A Sampling of CSU California Education Learning Lab (CELL) Awardees

Moderated by:
Dr. Frank A. Gomez
Executive Director, STEM-NET
Office of the Chancellor

https://www2.calstate.edu/impact-of-the-csu/research/stem-net

Frank A. Gomez *CSU Office of the Chancellor* *fgomez@calstate.edu*

The California State University
OFFICE OF THE CHANCELLOR

A Sampling of CSU California Education Learning Lab (CELL) Awardees

Speakers

Lark Park, California Education Learning Lab
Introducing the California Education Learning Lab

Ji Son, Cal State LA
The "Better Book" Approach: Using Student Data to Improve Introductory Statistics Materials

Delmar Larsen, UC Davis
ADAPT is Built for Multi-modal Use – Application

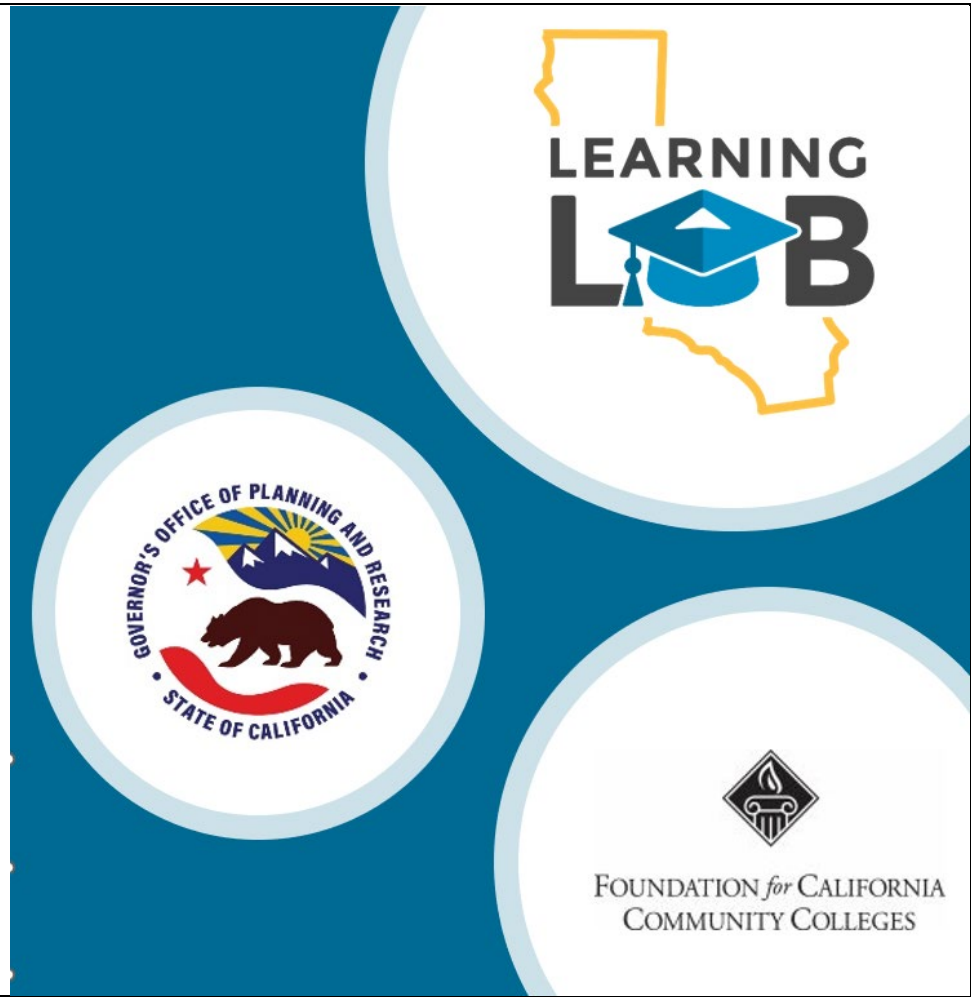
Sonal Singhal, CSU Dominguez Hills
Engaging Students as Scientists Through Authentic Research Inquiry

Earvin Balderama & Bianca Lopez Yendluri, Fresno State
The key to Success in STEM is Empowering all Students to take Ownership of their Learning

Youwen Ouyang & Marisol Clark-Ibáñez, CSU San Marcos
Giving the Ownership of Active Learning to Students in Computer Science (GOALS in CS)

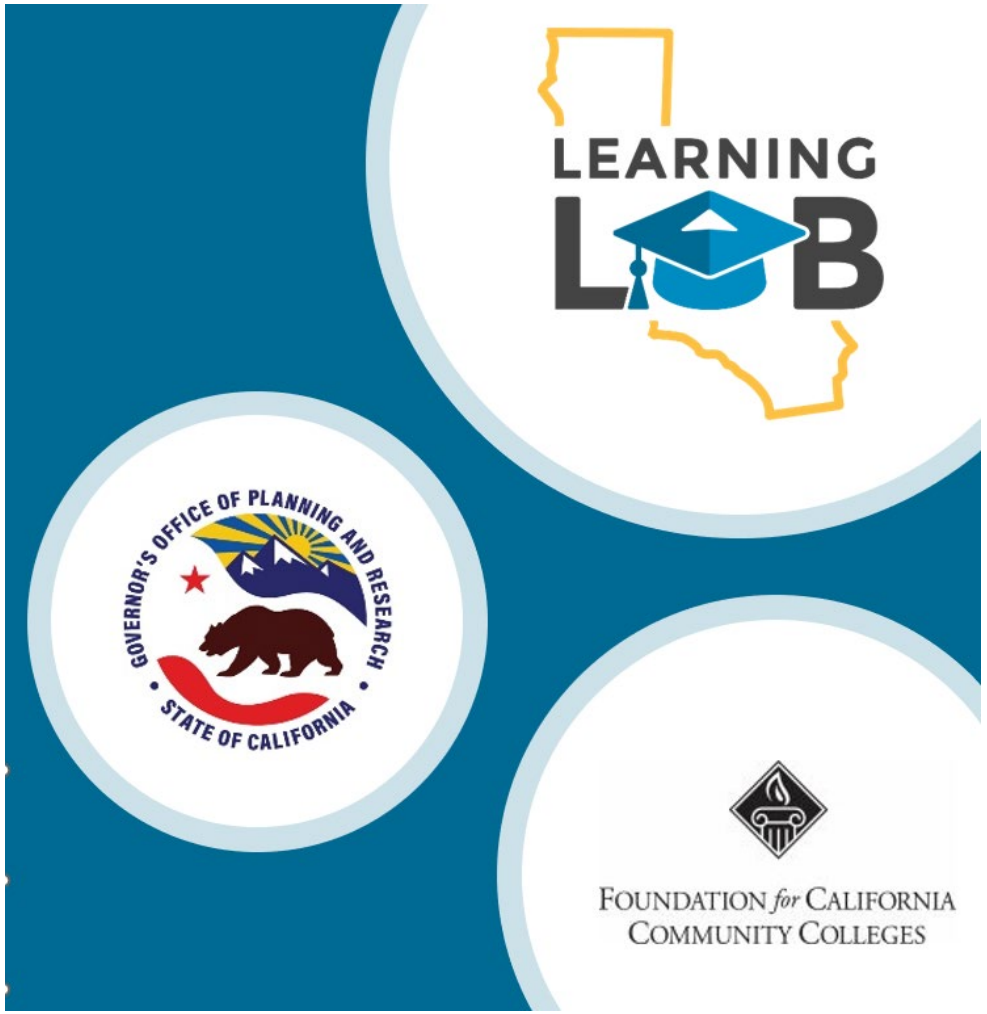
California Education Learning Lab

Lark Park, Director



Program Overview

- Established by Statute in 2018
- Housed in Governor's Office of Planning and Research
- Partnership with Foundation for CA Community Colleges
- Intersegmental by Design (CSU, UC, CCC)
- Initial Focus on STEM Success
- Innovation + Equity + Community
- 3 Core Areas:
  - Grantmaking
  - Community Building
  - Collecting & Promoting Best Practices



Program Overview

OUR MISSION

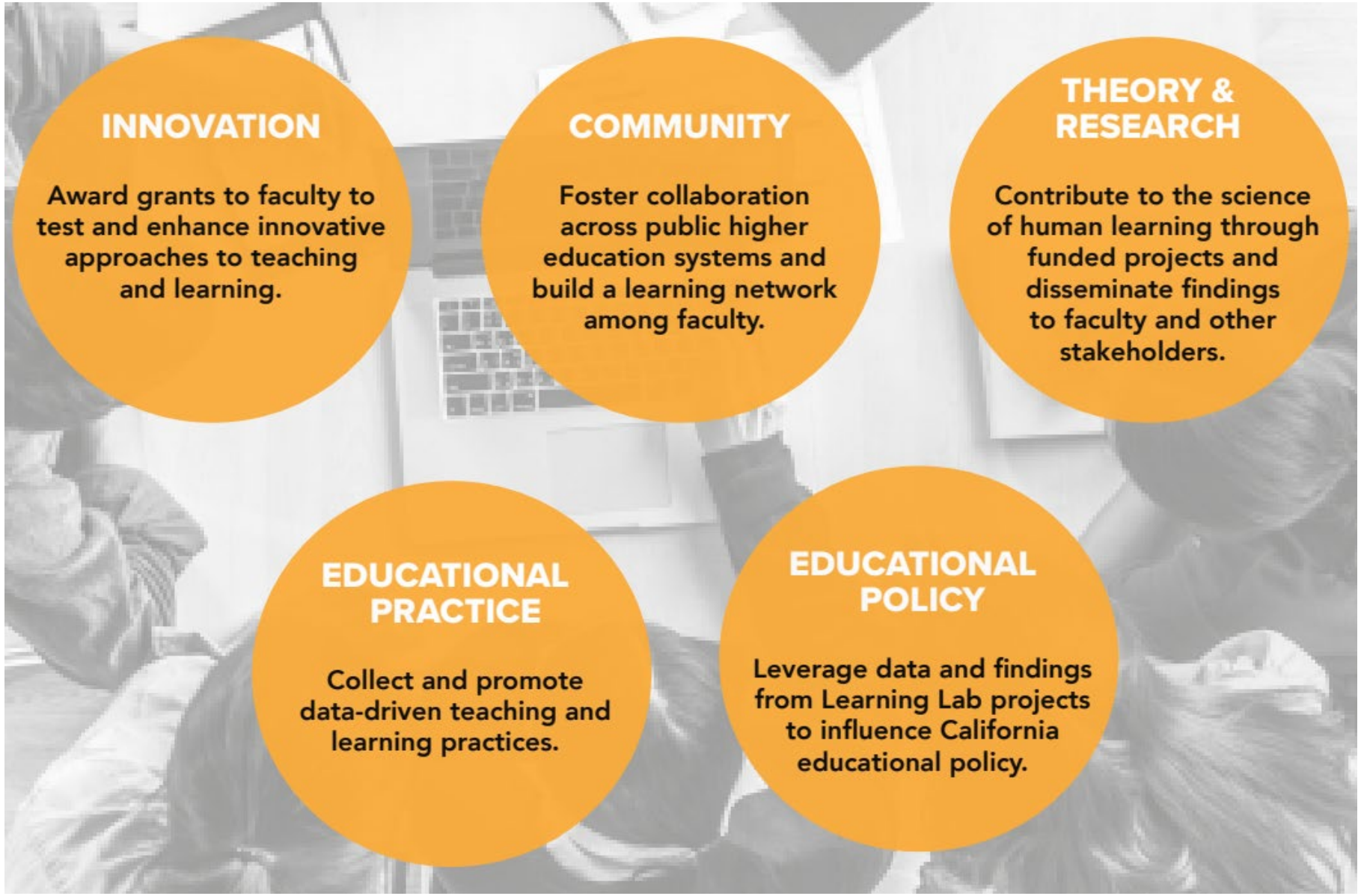
Improve learning outcomes and **close equity gaps** in California's public higher education institutions.

OUR VALUES

We operate on the premise that **all students are capable learners** with potential for success given the right conditions, supports, and motivations.

We believe that **faculty are our greatest resource** in helping students meet their goals, and that innovation begins with them.

Program Activities



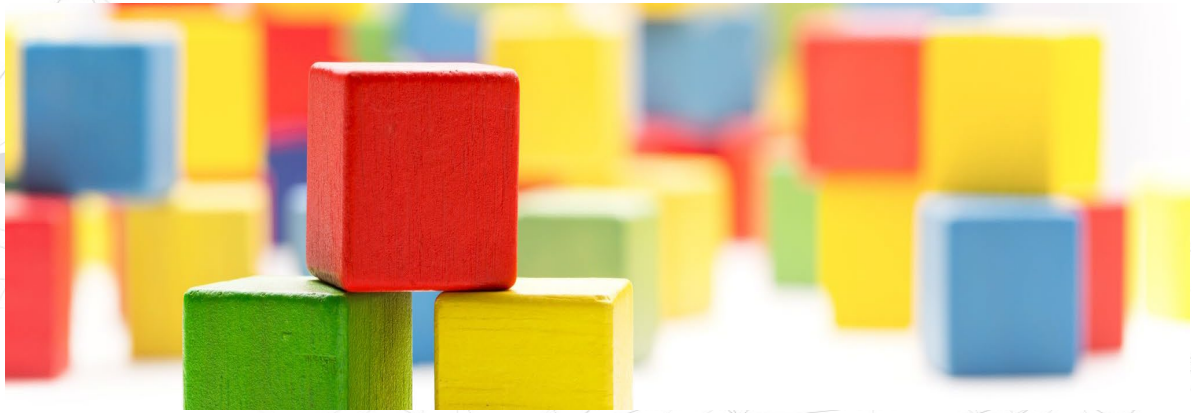
Funded Projects

- Seed & Prototype Projects
- Professional Development
- Demonstration Projects
- Institutional Change
- Grand Challenges

	GRANT OPPORTUNITY	DISCIPLINE	AWARD AMOUNT	DURATION	# of AWARDS
2018-19	Innovation		$1M-$1.3M	3 years	6 projects
	Demonstration Project		$500K	3 years	3 projects
2019-20	Innovation		$1M	3 years	5 projects
	Professional Development		$200K	2 years	5 projects
	Seed		$100K	2 years	6 projects
	Insitutional Change		$500K-$650K	2-3 years	5 projects
2020-21	Calculus Grand Challenge		$1.25M-$1.4M	3 years	4 projects
	Calculus Grant Challenge Cohort Facilitator		$500K	3 years	1 team
	Calculus Grant Challenge Prototype		$100K	1 year	4 projects
2021-22	Seeding Calculus Strategies (I)		$100K	2 years	15 projects
	Scaling Success		$200K-$700K	2 years	7 projects

Funded Project Building Blocks

- Technology
- Pedagogy
- Equity
- Student-centric
- Faculty-facing



Program Stats

Learning Lab in Action

$42.7M
in committed funding

82
funded projects

103
funded higher education institutions

475+
faculty leading funded projects

CSU Stats

- 23 of 23 campuses
- 160+ CSU faculty and other instructors as key personnel in awarded projects
- $12.7 million in funding direct to CSUs
- 55 unique projects
- Math & Data Science dominance
- Advisory Board Members Present & Past

Jeff Gold

Assistant Vice Chancellor for Student Success, California State University Office of the Chancellor

Eduardo M. Ochoa

President Emeritus, CSU Monterey Bay
Former Assistant Secretary of Education

Kimberly Tanner

Program Director, Division of Undergraduate Education, National Science Foundation

Carlos Gutierrez

Distinguished Professor of Chemistry Emeritus & Founding Director of Minority Opportunities & Research Programs, Cal State LA

James T. Minor

Chancellor, Southern Illinois University, Edwardsville

Why Apply?

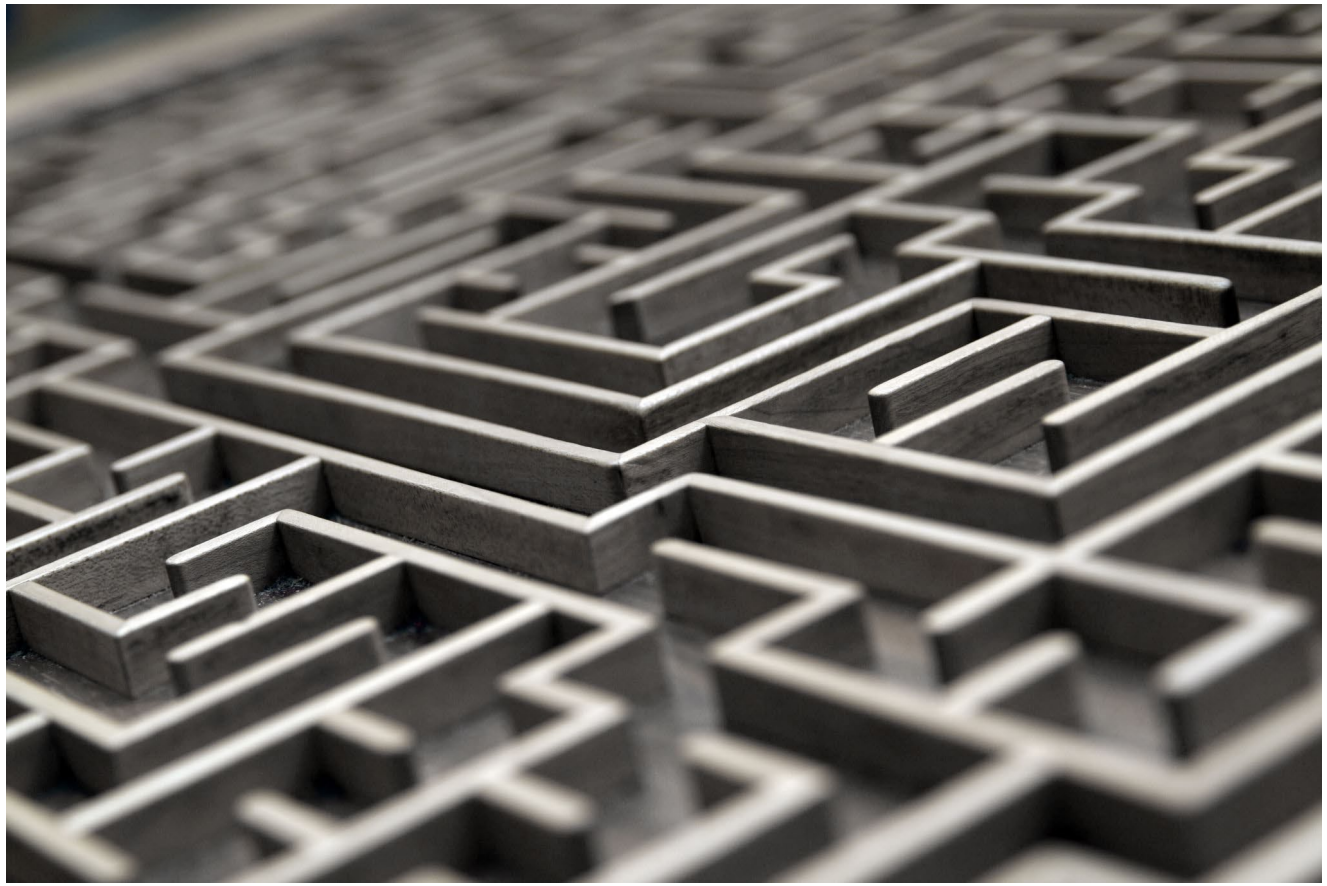
- CSU Graduation Initiative
- COVID-19 Impacts
- Equity Matters
- Students Have Changed
- Community
- Generative AI

"Support from the Learning Lab was incredibly important to the success of this work. Beyond the fiscal support, the symbolic value of having such an important program provide backing, advice, structure, and connections cannot be overstated." (Increasing Student Flow and Success Along Intersegmental STEM Program Pathways)

"Thank you for this opportunity. The Learning Lab is making a difference!" (Eliminating Equity Gaps in Online Gateway STEM Courses through Humanized Instruction)

Lessons from the Past Five Years

- Change leadership is necessary
- Administrative hurdles can be addressed
- Intersegmental work is rewarding
- Sustainability is inconsistent
- Scalability will require different models
- Difficult, tumultuous times will continue



Next Grant Opportunity

Fill Out Our Survey!

- https://calearninglab.org/ai-call-for-ideas/

Next Steps for Learning Lab

AI CALL FOR IDEAS SURVEY

PROFESSIONAL LEARNING/ PROFESSIONAL DEVELOPMENT

LEARNING LAB ASSET DATABASE (LLAD)

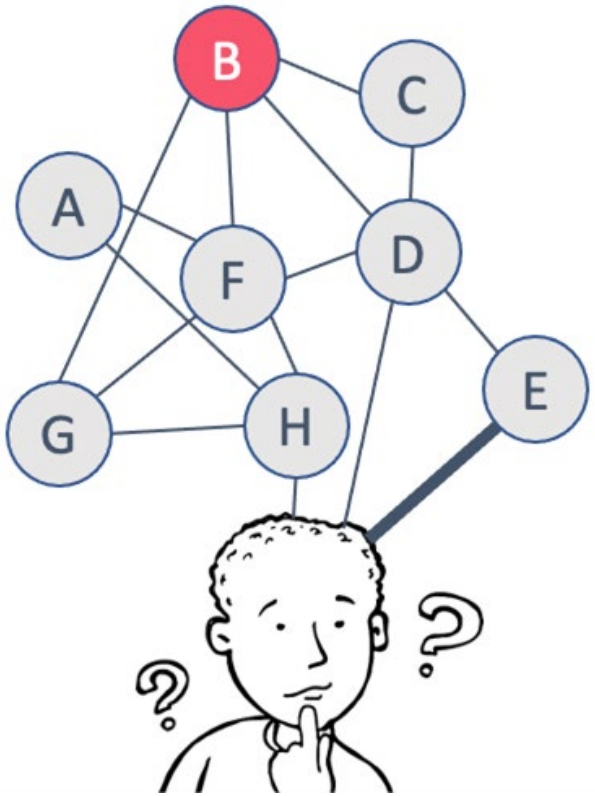
CONTINUOUS IMPROVEMENT ON GRANTMAKING

EXPAND OUTREACH

Our Next Convening

Questions?

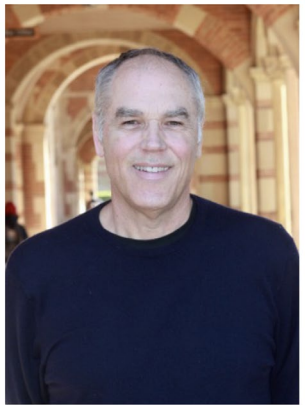
lark.park@calearninglab.org



The "Better Book" Approach: Using Data to Improve Statistics Education

Ji Y. Son, PhD, Cal State LA

Collaboration Across Segments and Systems of Education


Jim Stigler


Alice Xu

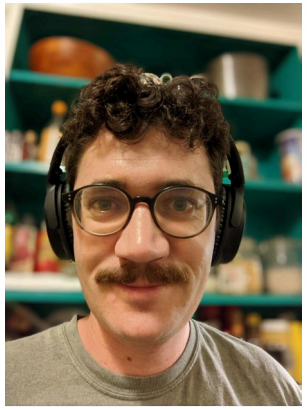

Jose Salas


Karen Givvin


Eddie Tchertchian


Adam Blake


Matt Jackson

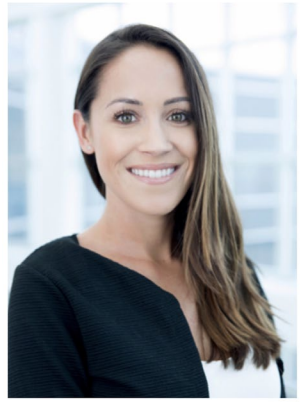

Ben Smith


Caylor Davis


Jinna Hwang


Ben Winjum


Icy Zhang


Claudia Sutter


Ken Sorey

Teaching Hard Things to All Students

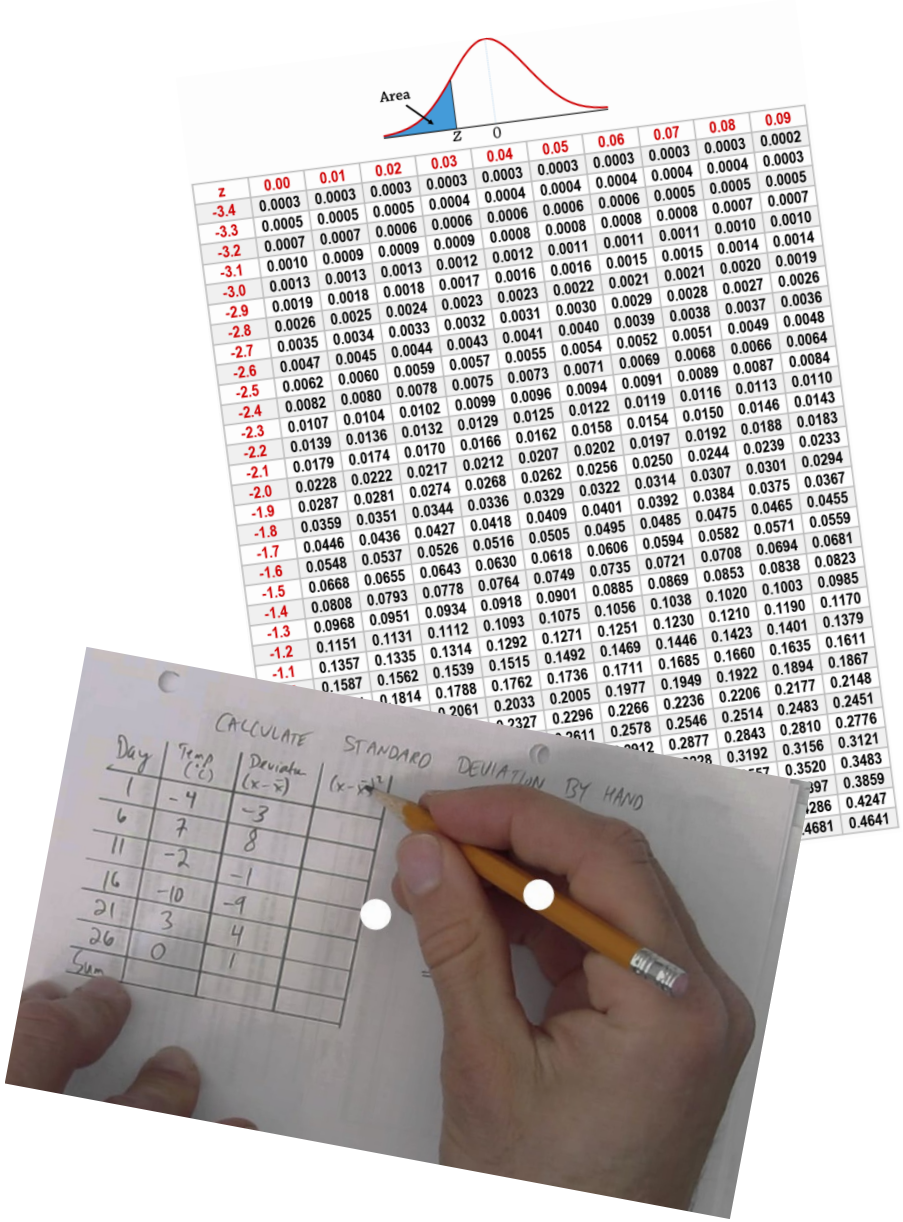
After CA community colleges reduced developmental math courses (AB705),

50% of math enrollment is now in statistics courses.

A similar (albeit less widely studied) CSU policy is Chancellor's Office EO1110.

SLAM, statistics and liberal arts math: https://www.ppic.org/publication/community-college-math-in-californias-new-era-of-student-access/

OPPORTUNITY TO MODERNIZE STATS



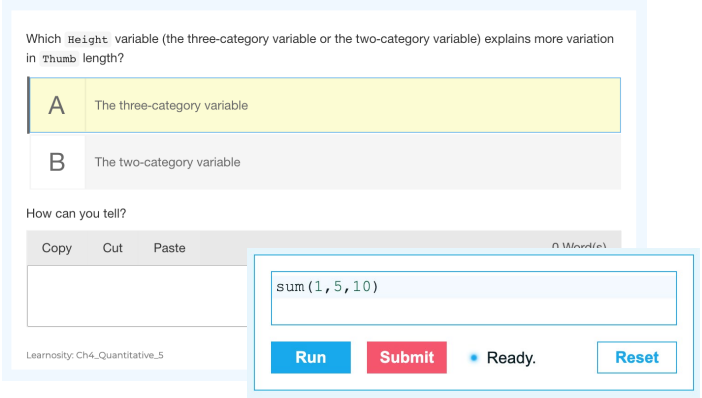
OPPORTUNITY TO MODERNIZE STATS

A Modeling Approach

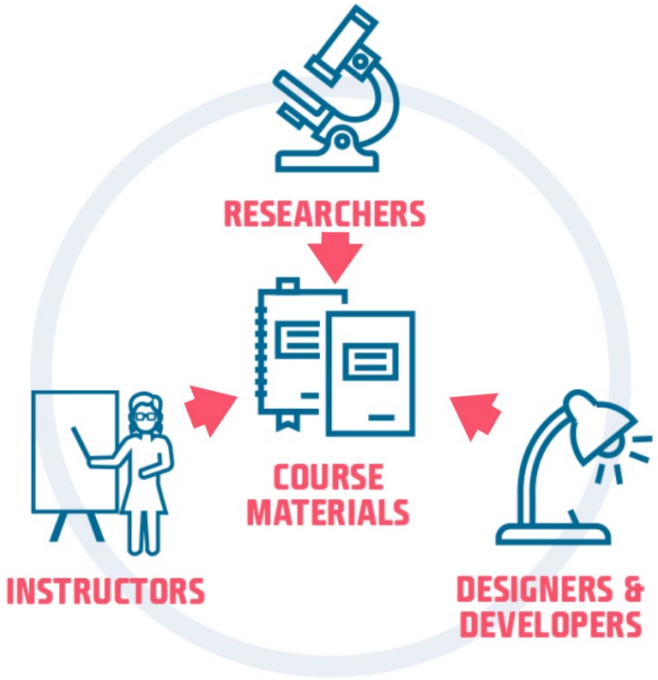
DATA = MODEL + ERROR

Connecting stats to modeling with algebraic functions

Interactive Textbook (R)

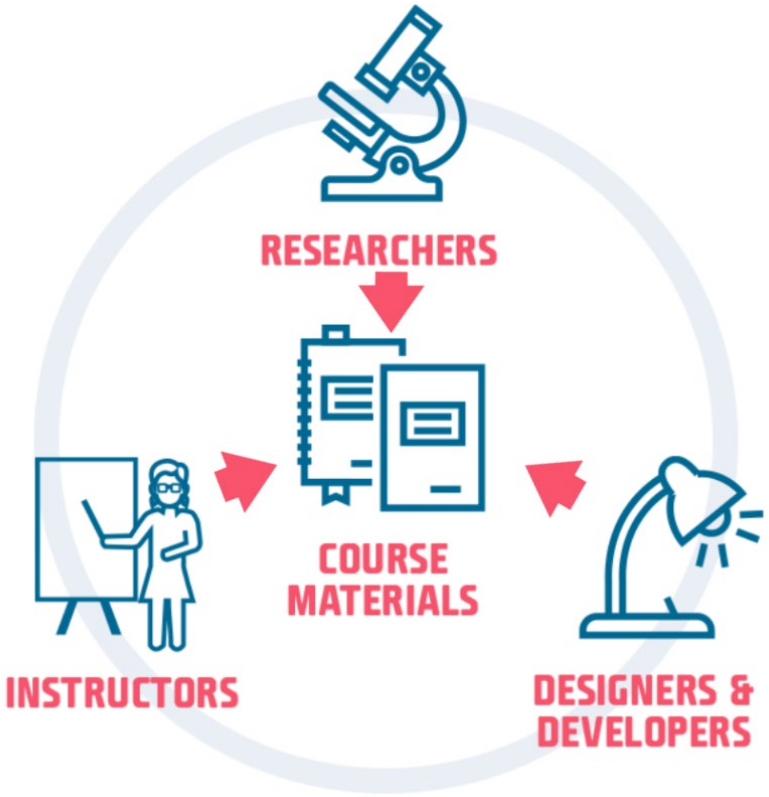


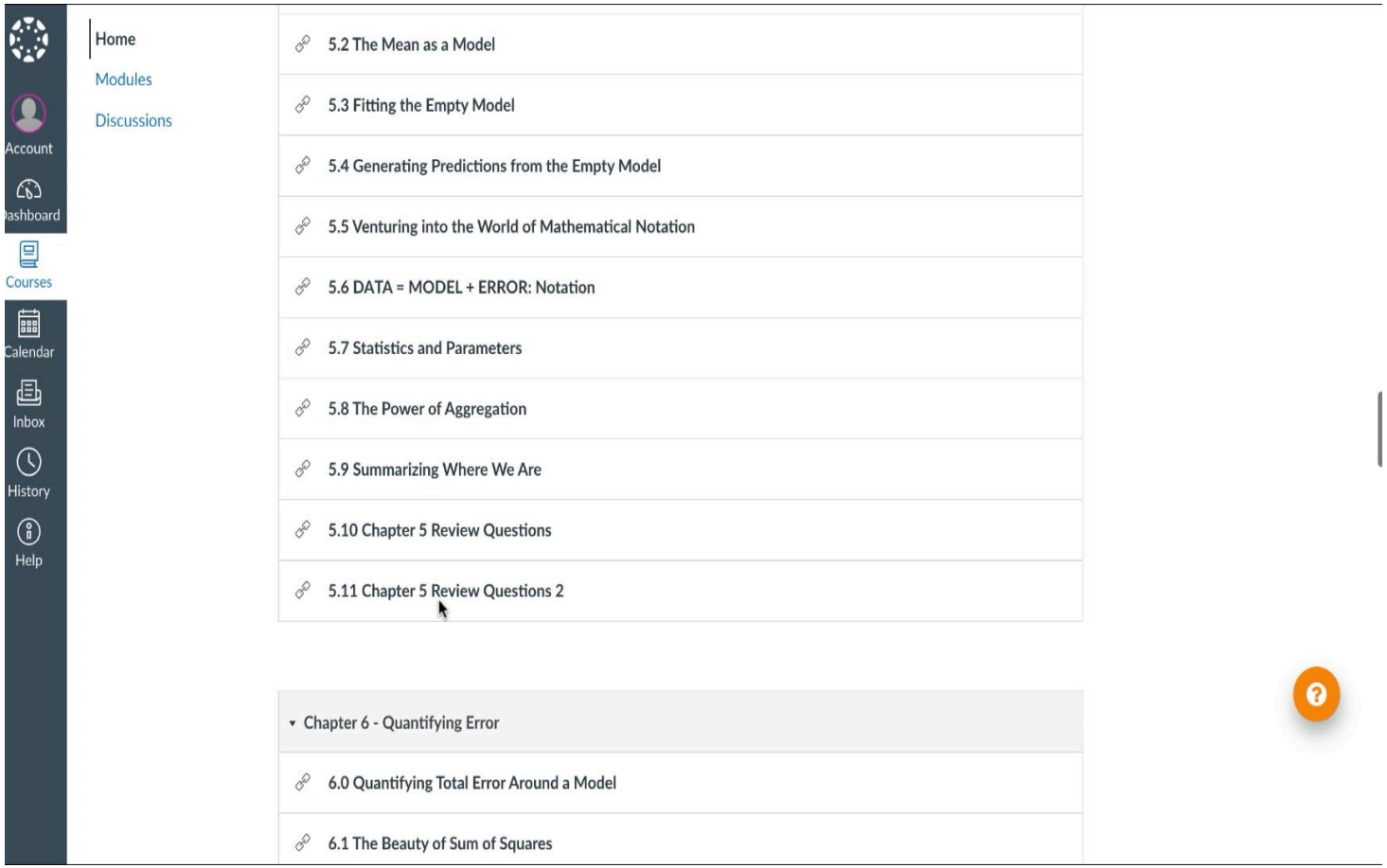
In-Class Jupyter Notebooks

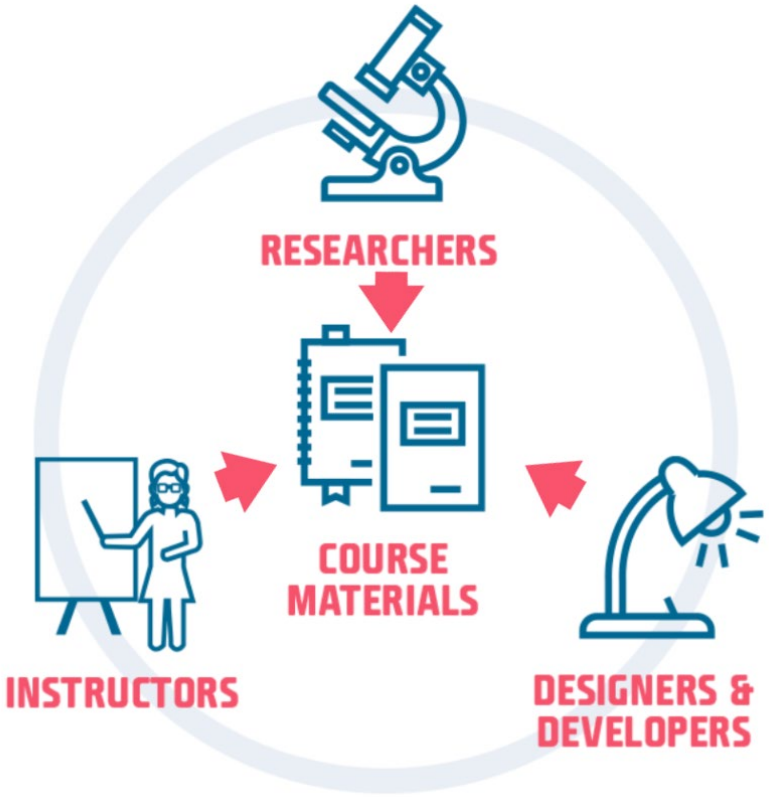


OPPORTUNITY TO MODERNIZE

HOW WE STUDY STUDENT LEARNING


RESEARCHERS
COURSE MATERIALS
INSTRUCTORS
DESIGNERS & DEVELOPERS


Home
Modules
Discussions
Account
Dashboard
Courses
Calendar
Inbox
History
Help
5.2 The Mean as a Model
5.3 Fitting the Empty Model
5.4 Generating Predictions from the Empty Model
5.5 Venturing into the World of Mathematical Notation
5.6 DATA = MODEL + ERROR: Notation
5.7 Statistics and Parameters
5.8 The Power of Aggregation
5.9 Summarizing Where We Are
5.10 Chapter 5 Review Questions
5.11 Chapter 5 Review Questions 2
Chapter 6 - Quantifying Error
6.0 Quantifying Total Error Around a Model
6.1 The Beauty of Sum of Squares



The "Better Book" Model

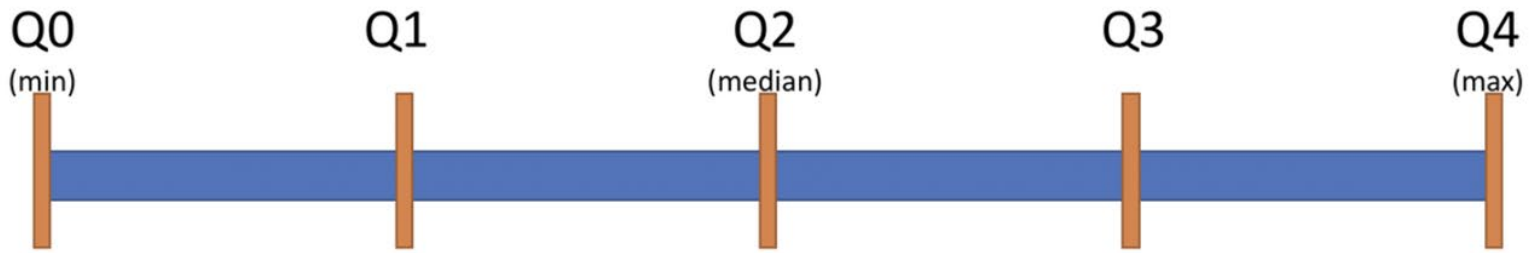
Using student data to *improve* how we teach statistics.

What did we learn?

Example 1: Small Improvements!

Excerpt:

It is important to note that what is equal about the four quartiles is the number of data points included in each...



Example 1: Small Improvements!

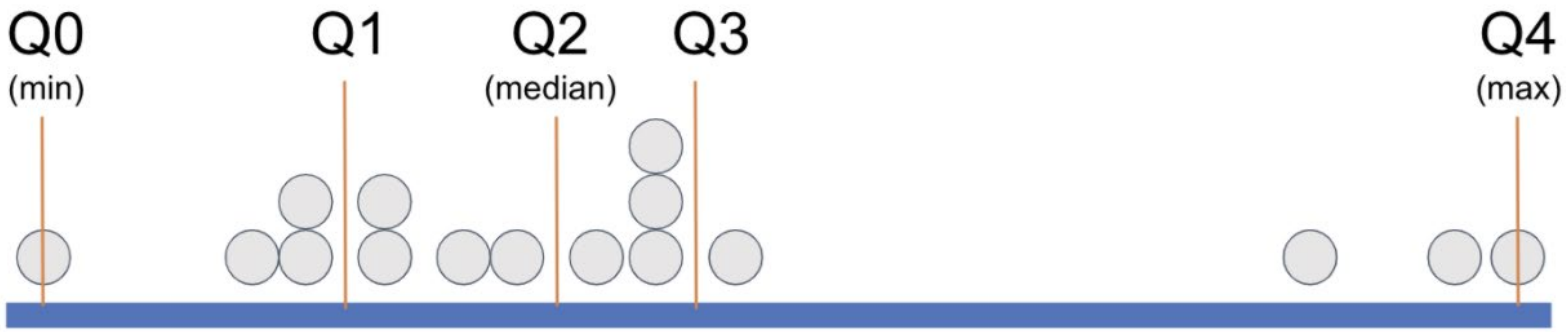
The quartiles are equally sized. What is "equal" about the quartiles?

A	They each have the same range on the variable (i.e., 1-10, 11-20, 21-30, 31-40).	28%
B	They each have the same data points.	1%
C	They each have the same number of data points.	46%
D	They each have the same interval.	25%

Example 1: Small Improvements!

Excerpt:

It is important to note that what is equal about the four quartiles is the number of data points included in each...



Example 1: Small Improvements!

The quartiles are equally sized. What is "equal" about the quartiles?

A	They each have the same range on the variable (i.e., 1-10, 11-20, 21-30, 31-40).	8%
B	They each have the same data points.	5%
C	They each have the same number of data points.	84%
D	They each have the same interval.	3%

Example 2: COVID x Campus

In-person

Remote

Importance of context!

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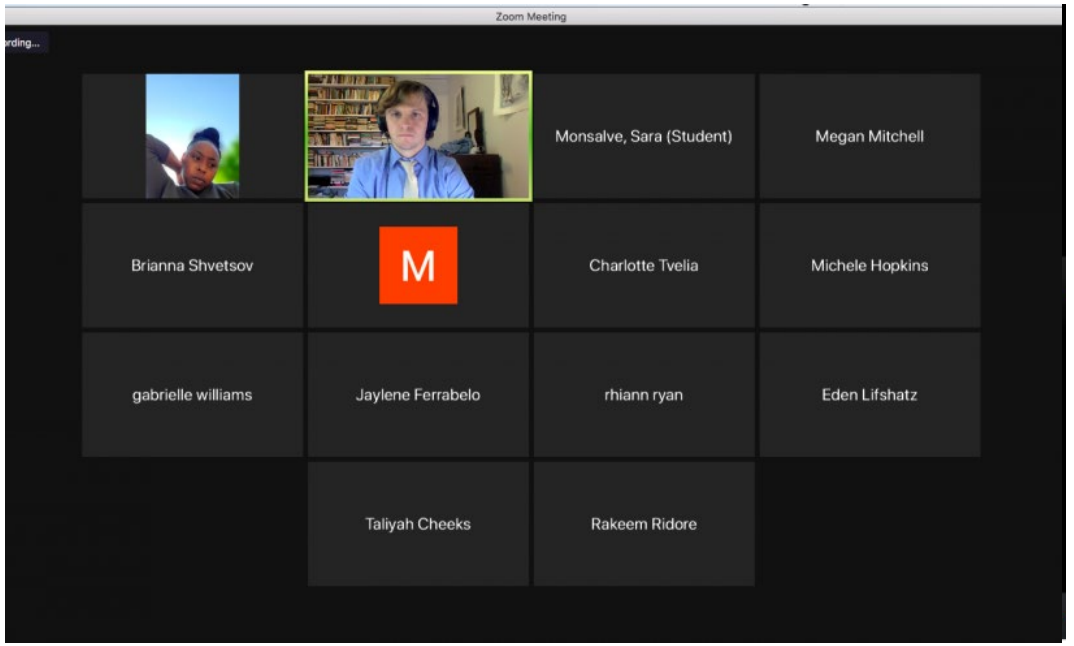
In-person

Remote



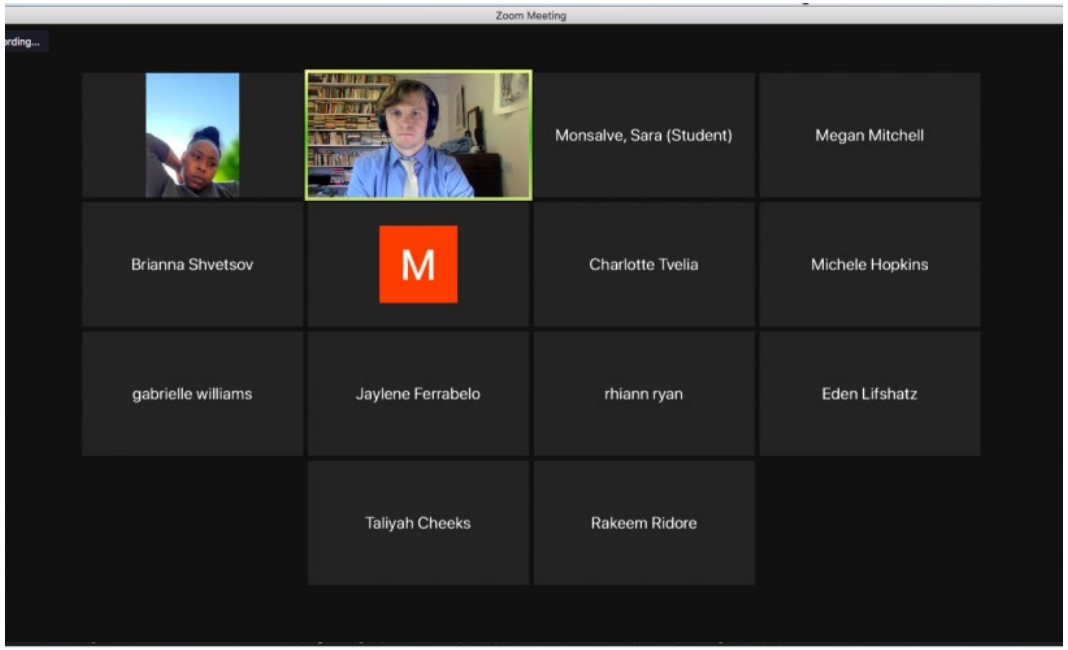
Importance of context!

Example 2: COVID x Campus

UNIVERSITY OF CALIFORNIA

CSU The California State University

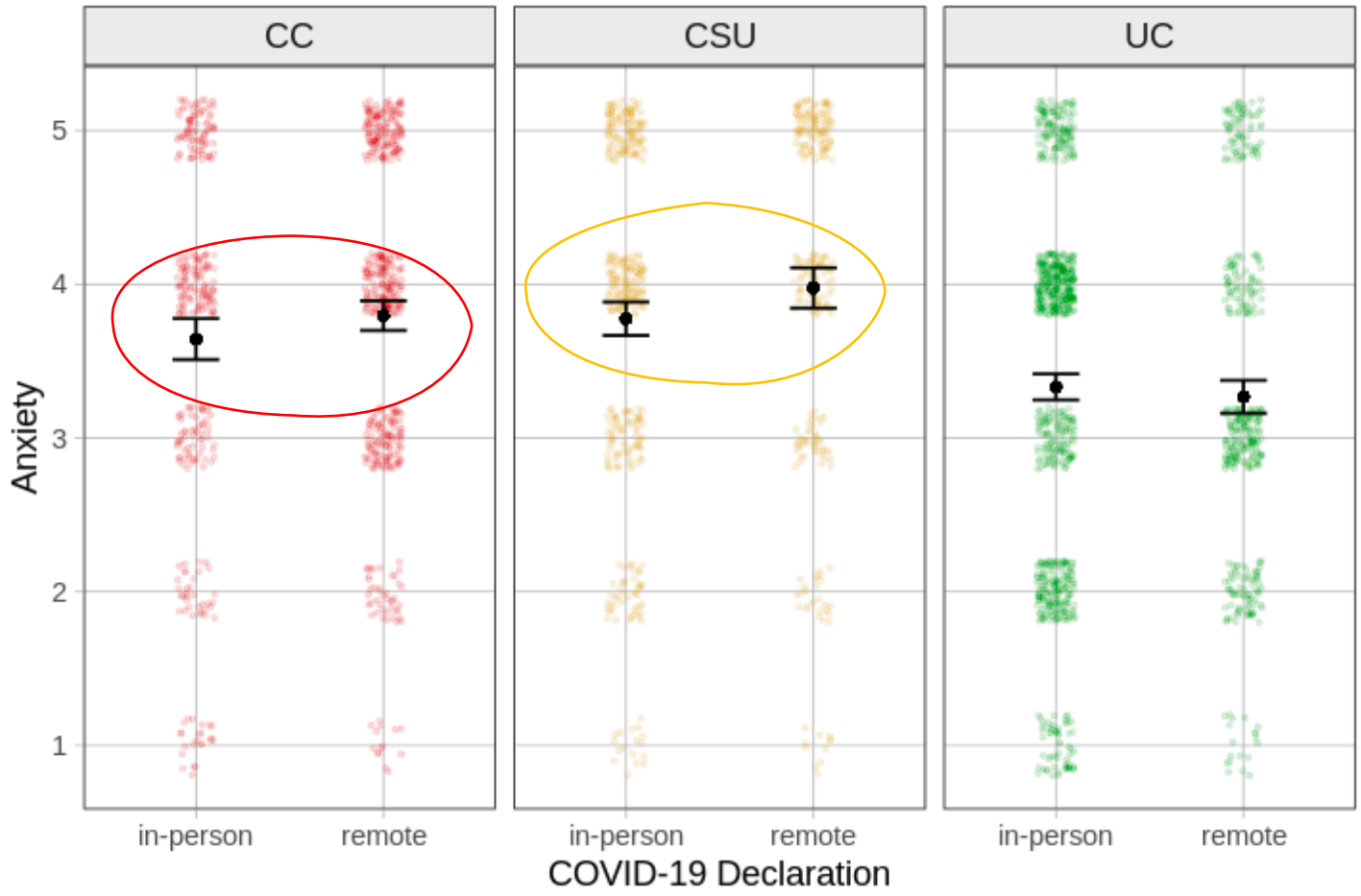
California Community Colleges



Importance of context!

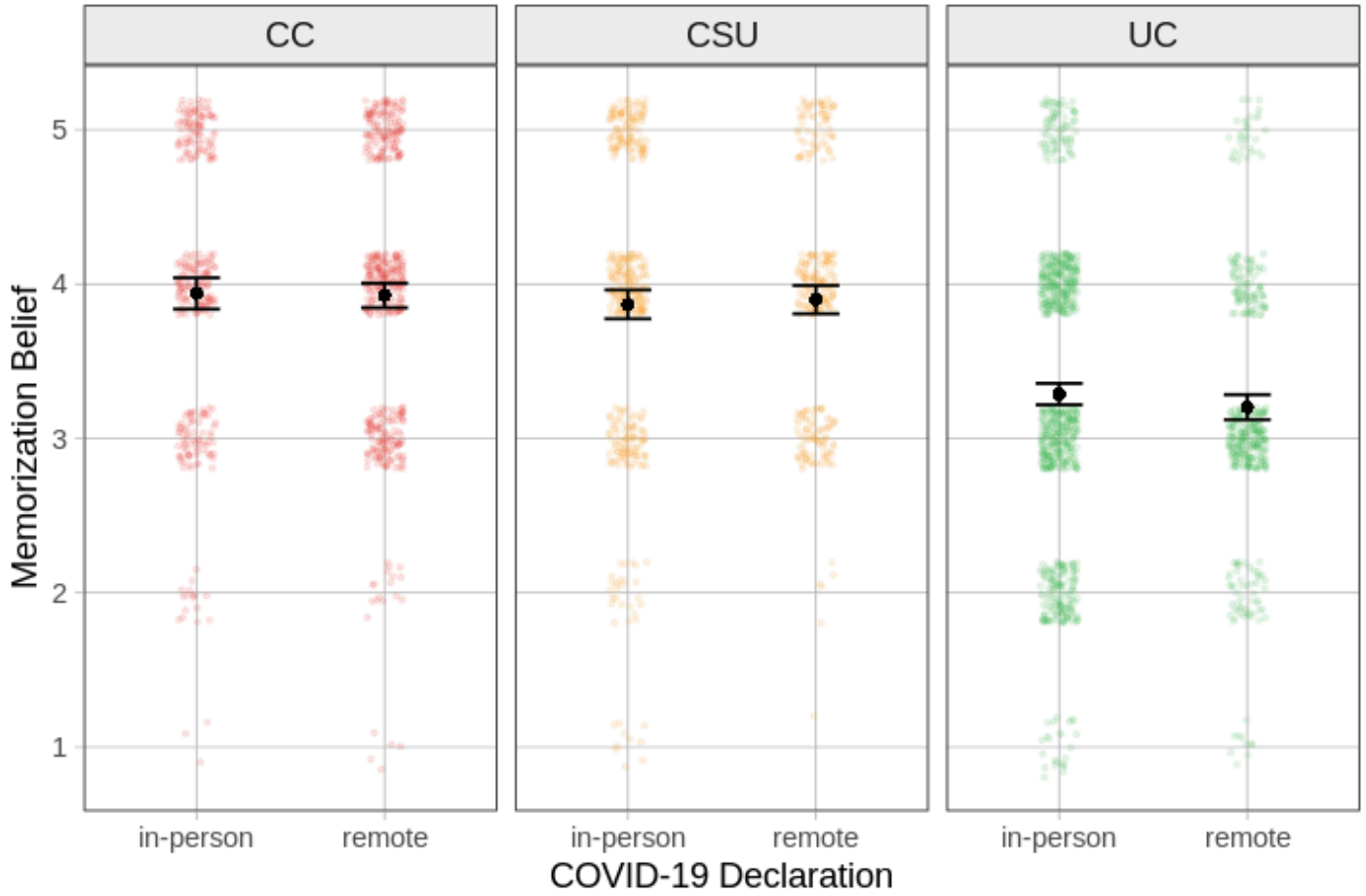
Example 2: COVID x Campus

Increases in Anxiety in CC and CSU



Example 2: COVID x Campus

Even with more open policies, no changes in beliefs about memorization



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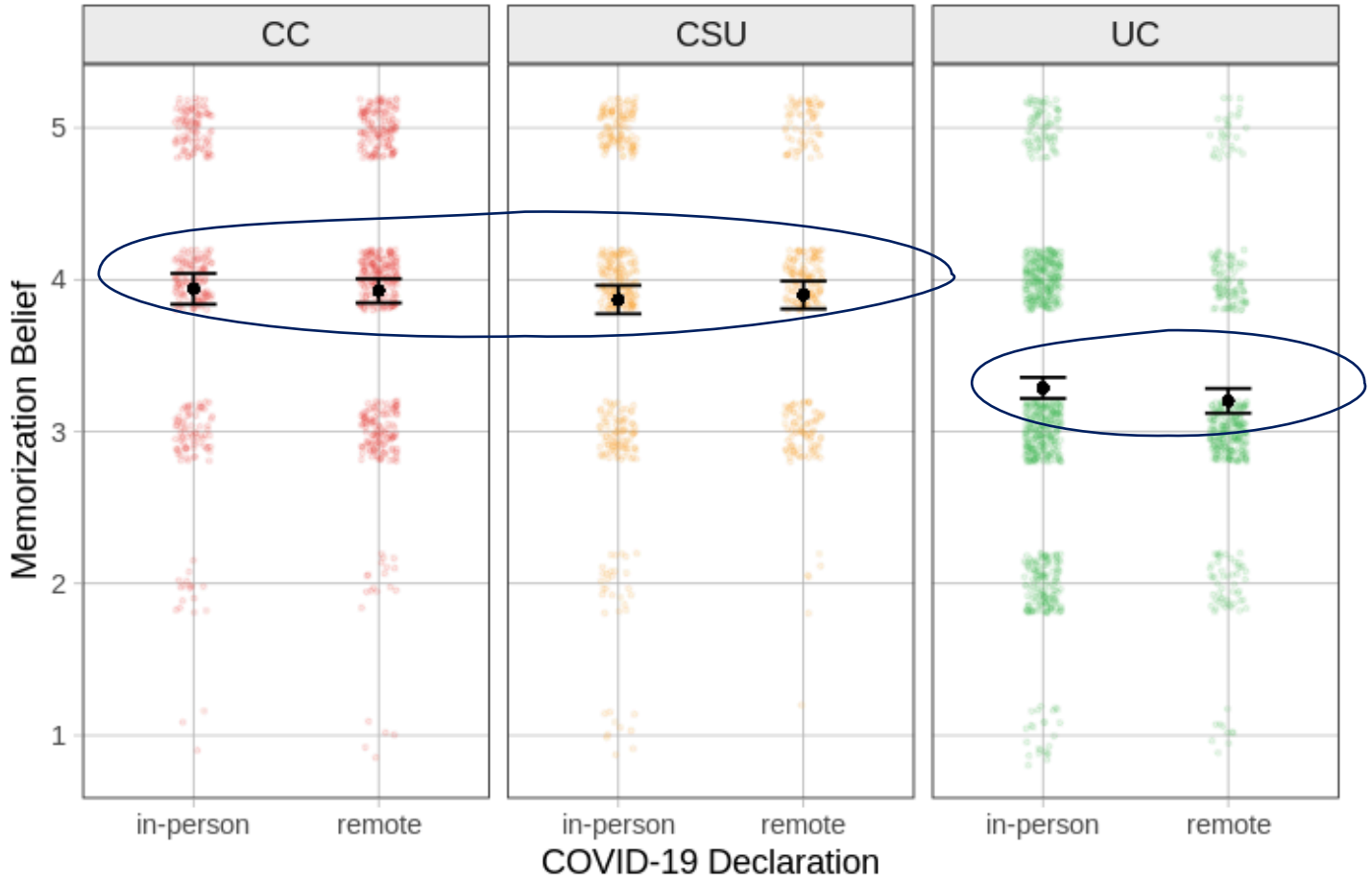
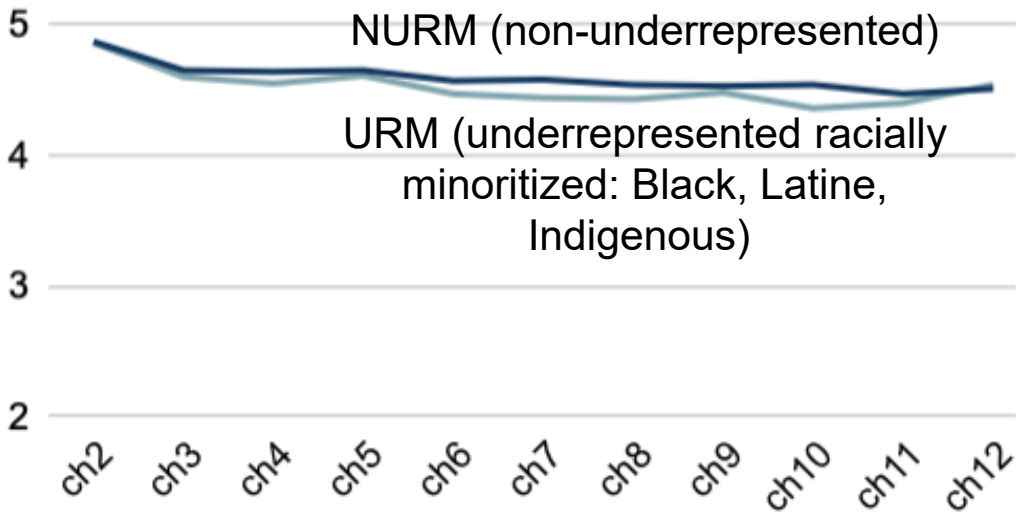


Example 3: Design for Equity

Utility Value: the relevance and perceived usefulness of content



Sutter, C.C., Tucker, M., Givvin, K.B., & Hulleman, C.S. (under review).
Concerns and challenges in introductory statistics and correlates with motivation and future interest.

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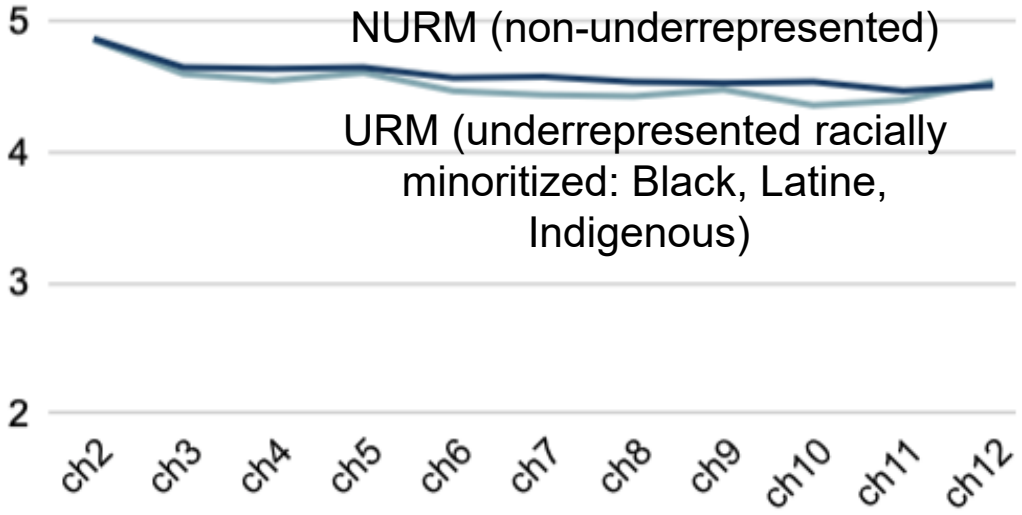
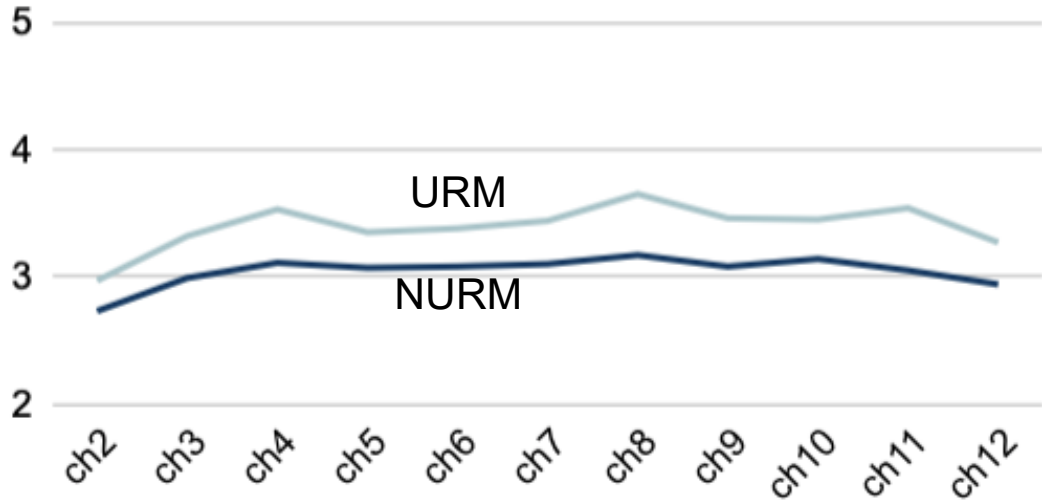


Cost: perceived time and energy needed to succeed in this chapter



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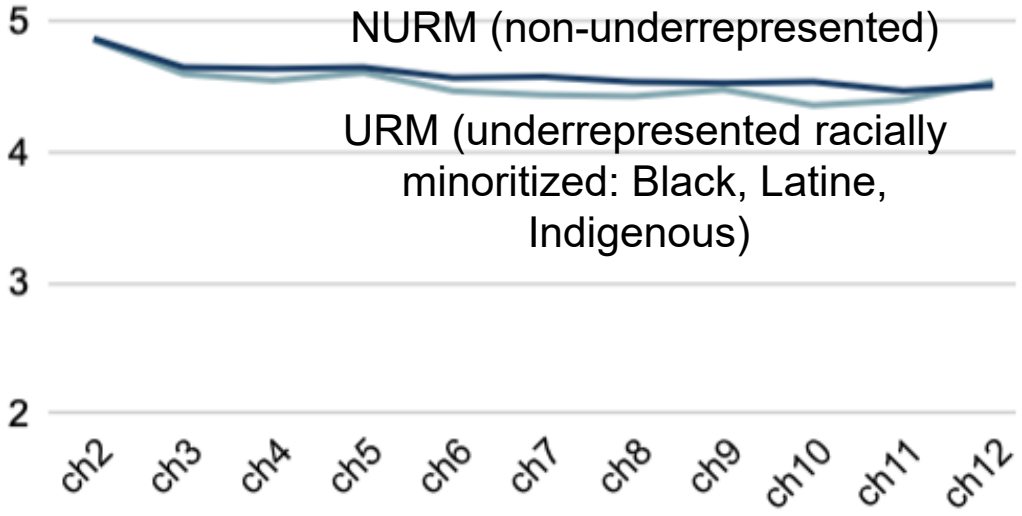

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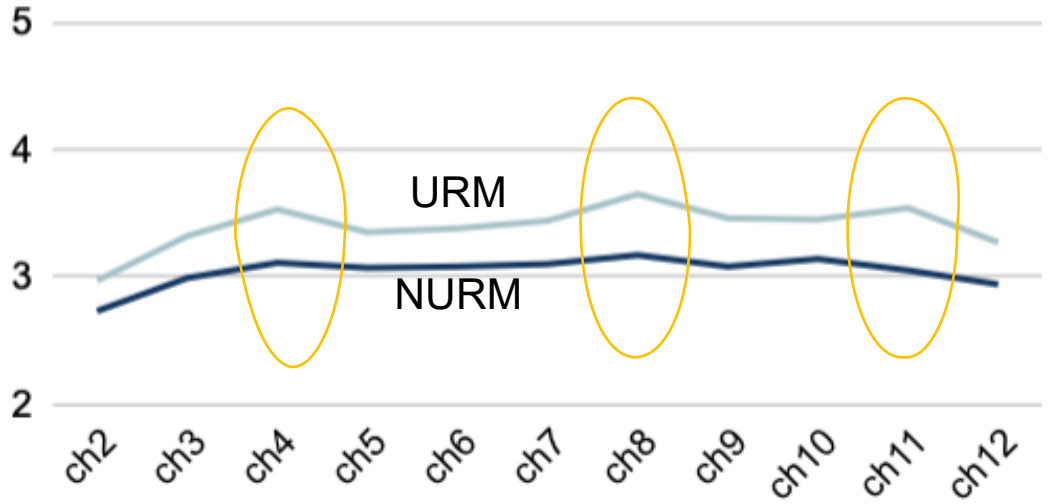

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Example 3: Design for Equity

V4.0:

- Page lengths inconsistent
- Ch7 twice as long as others
- Notation for models introduced before visual representation

V5.0:

- More consistent length of pages
- Split contents of Ch7 into 2 chapters
- Visual introduction to models before notation

Sutter, C.C., Jackson, M.C., Givvin, K.B., Stigler, J.S., & Son, J.Y. (in preparation). The "Better Book" Approach to Addressing Equity in Statistics. *Education Sciences.*

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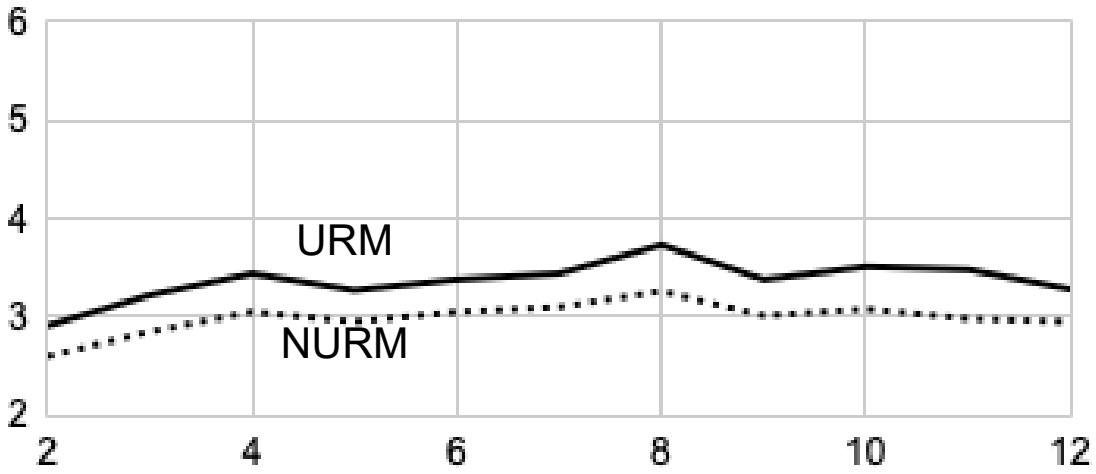

V5.0:

- More consistent length of pages
- Split contents of Ch7 into 2 chapters
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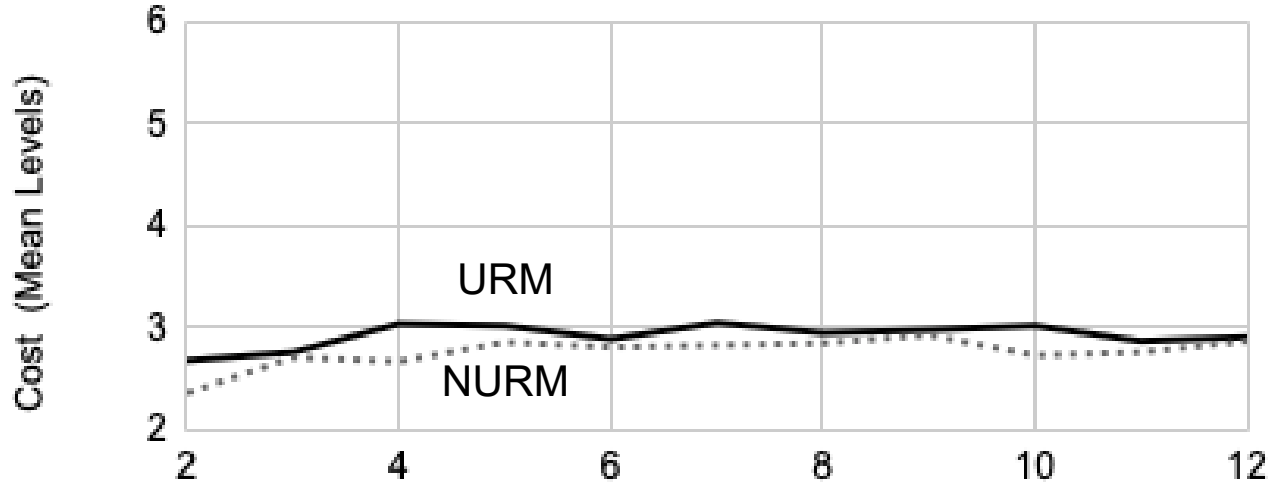

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CSU
The California State University

Introducing The ADAPT Open Homework and Assessment Platform

Delmar Larsen
Executive Director, LibreTexts
Professor, Department of Chemistry,
University of California, Davis

- **ADAPT** (https://ADAPT.LibreTexts.org)
- **Studio** (https://studio.libretexts.org)

ADAPT is brought to you by the California Education Learning Lab

How do you build an online homework system that complements the utility of the LibreTexts Infrastructure and is:

- Flexible,
- Dynamic,
- Comprehensive,
- Integrated,
- LMS agnostic,
- Powerful, &
- and free or nearly free?

Slowly and Efficiently

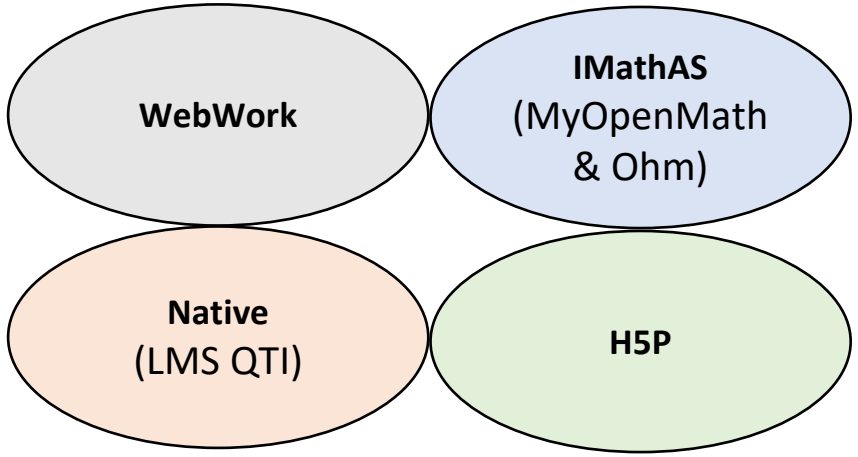
Don't reinvent the wheel!

IBM.

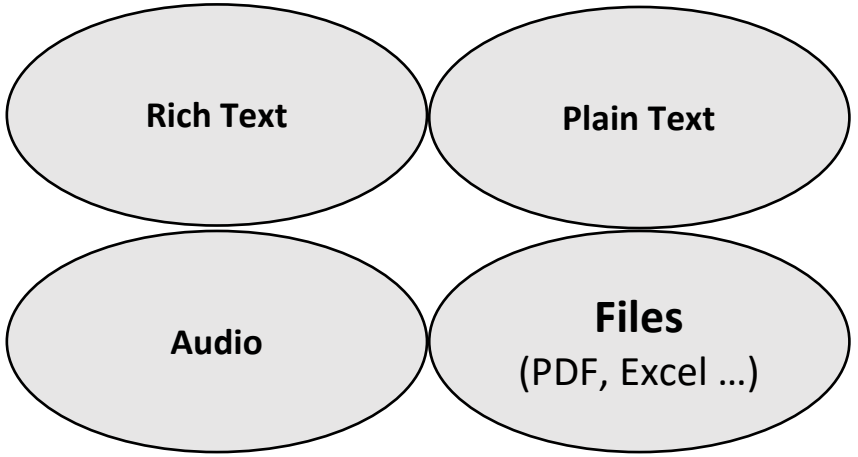
ADAPT is Built for Multi-modal Use - Technology

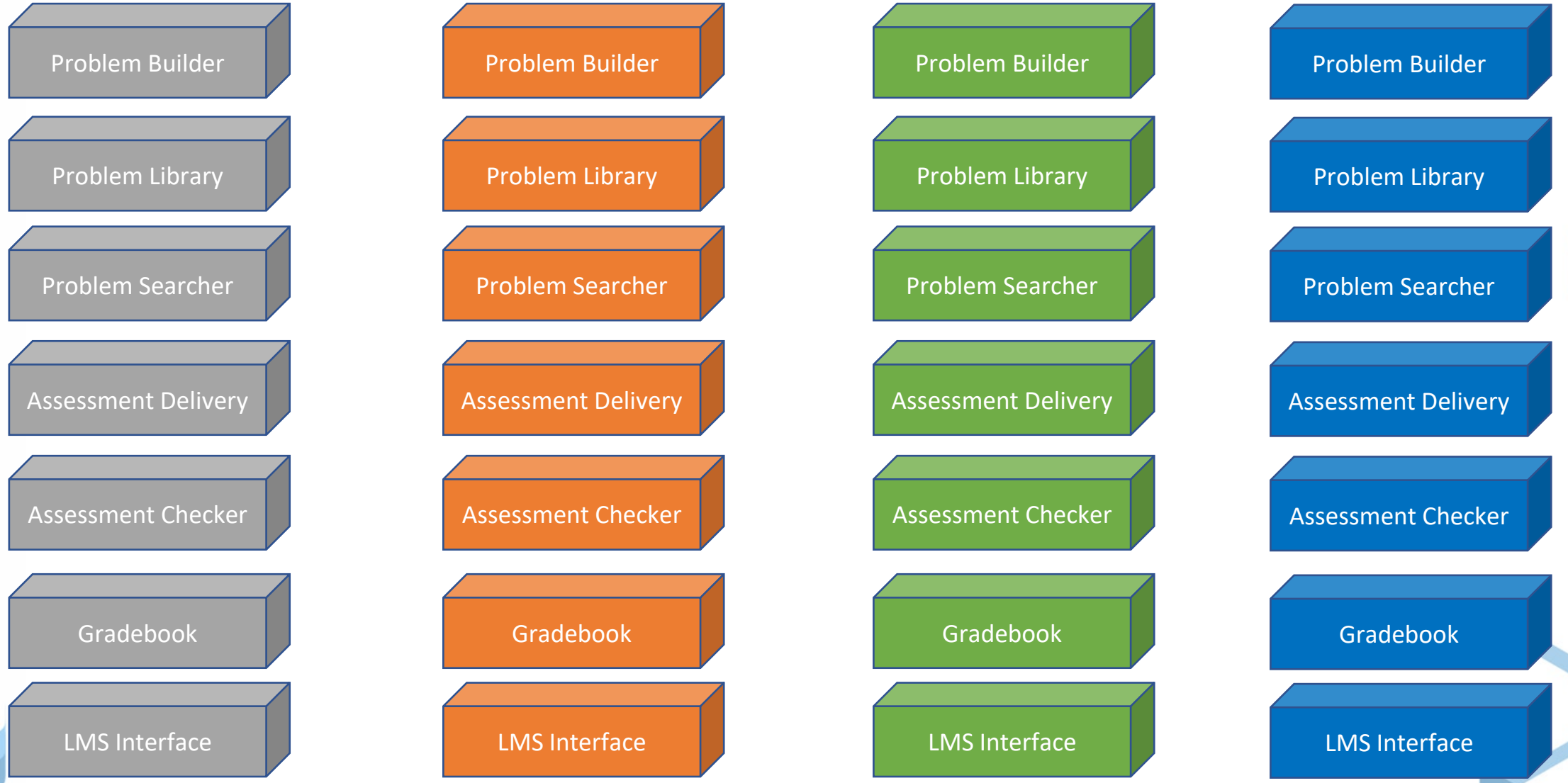
No single technology can handle all use cases. Our solution is to build ADAPT with multiple technologies capable of handling numerous use cases.

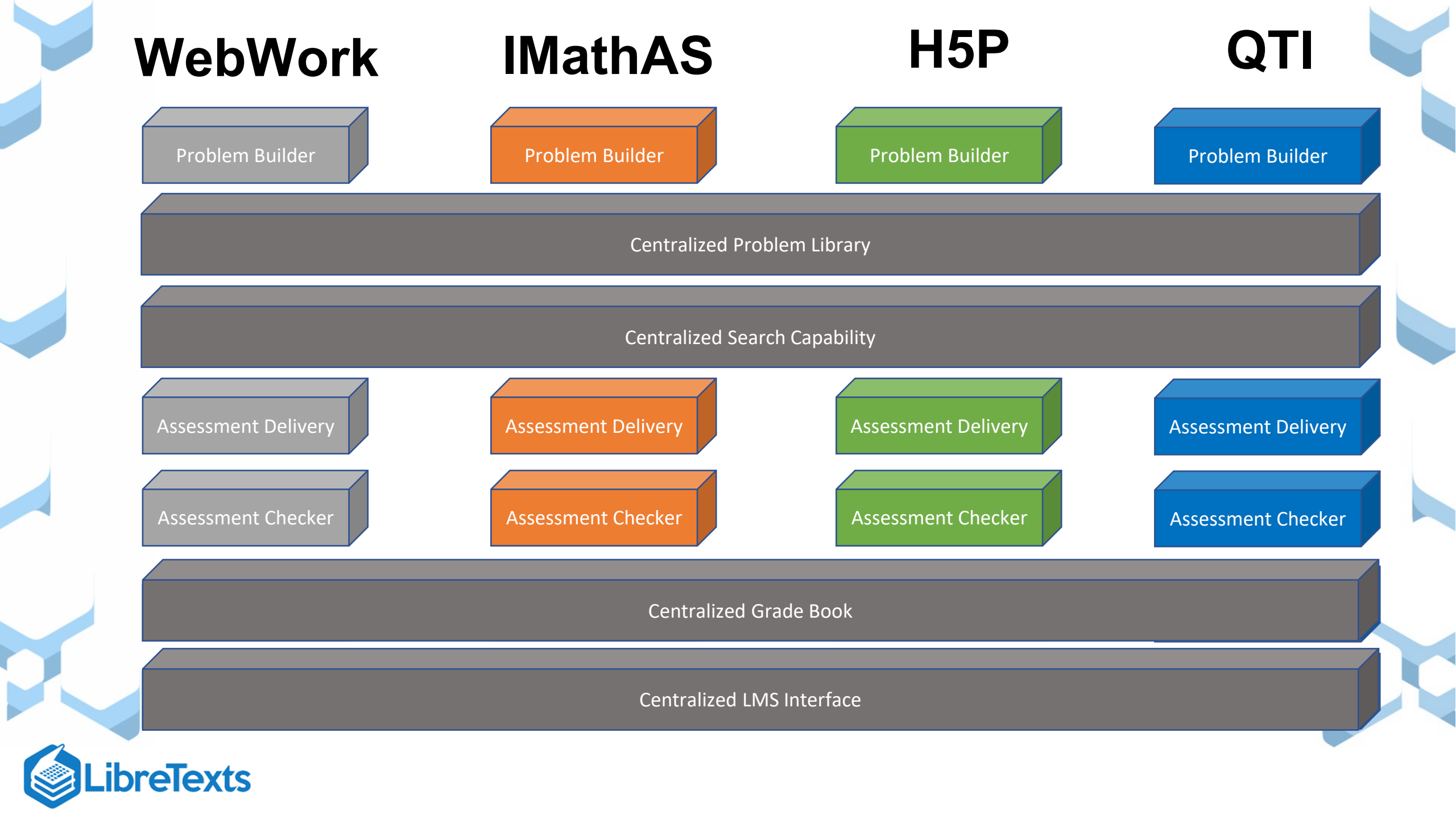
AutoGraded Questioning



Open-Ended Questioning

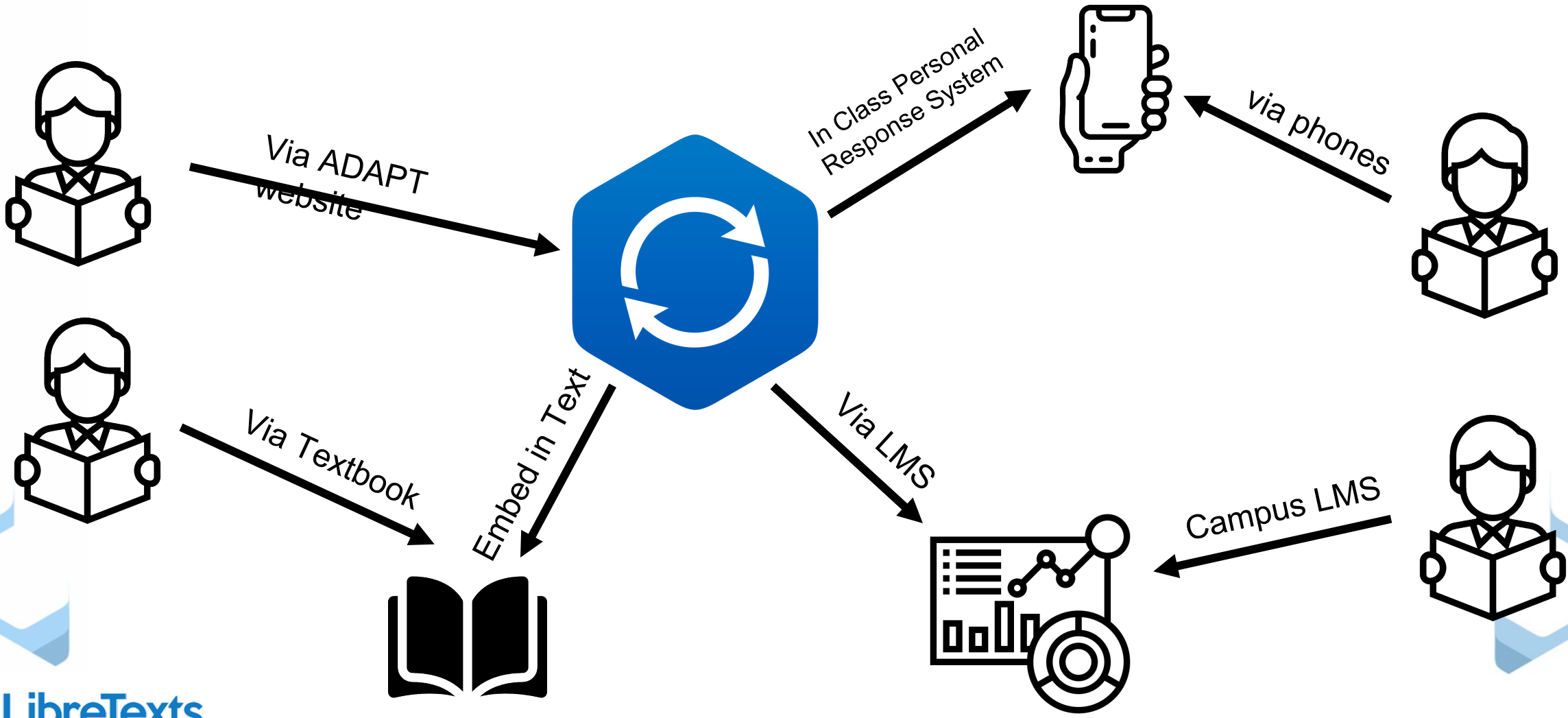



WebWork
Problem Builder
Problem Library
Problem Searcher
Assessment Delivery
Assessment Checker
Gradebook
LMS Interface
IMathAS
Problem Builder
Problem Library
Problem Searcher
Assessment Delivery
Assessment Checker
Gradebook
LMS Interface
H5P
Problem Builder
Problem Library
Problem Searcher
Assessment Delivery
Assessment Checker
Gradebook
LMS Interface
QTI
Problem Builder
Problem Library
Problem Searcher
Assessment Delivery
Assessment Checker
Gradebook
LMS Interface

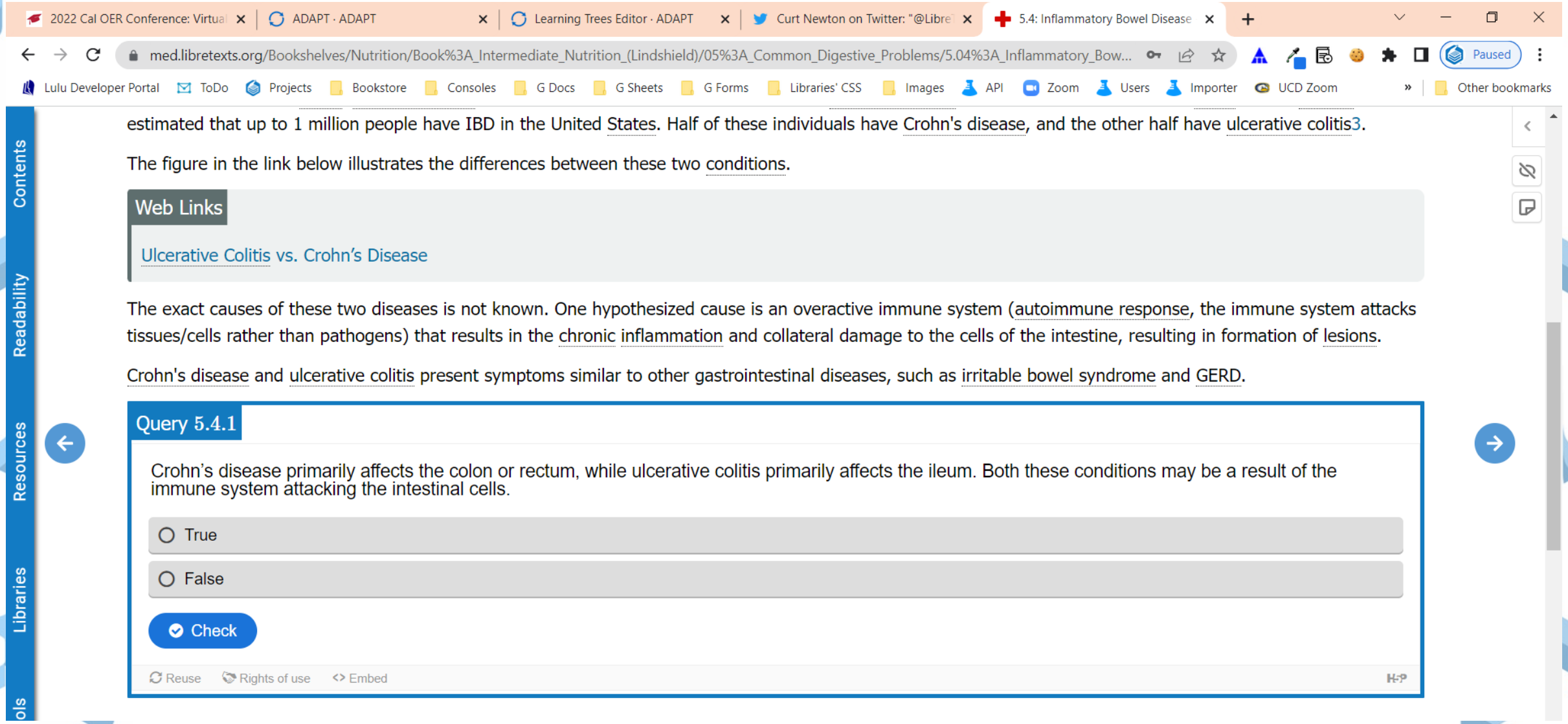

WebWork
IMathAS
H5P
QTI
Problem Builder
Problem Builder
Problem Builder
Problem Builder
Centralized Problem Library
Centralized Search Capability
Assessment Delivery
Assessment Delivery
Assessment Delivery
Assessment Delivery
Assessment Checker
Assessment Checker
Assessment Checker
Assessment Checker
Centralized Grade Book
Centralized LMS Interface

ADAPT is Built for Multi-modal Use – Application

Different Instructors have different pedagogies in their use of Homework.



ADAPT: Textbook Access



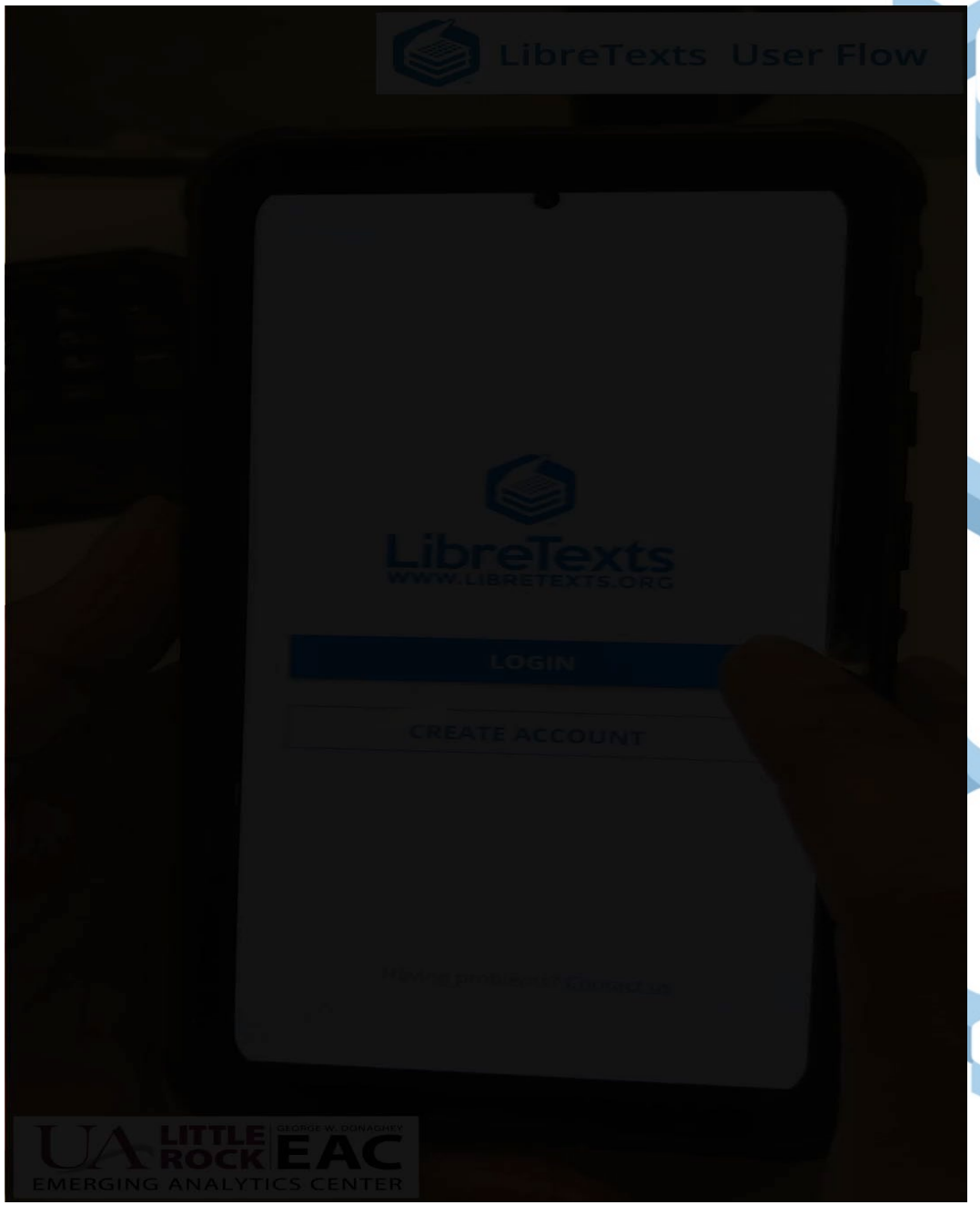
LibreTexts

Anywhere and Anytime

User ADAPT as a handheld homework interface for easy access to homework.

Use ADAPT as a **Personal Response Systems**: This enables instructors to pose questions to students and immediately collect and view the responses of the entire class.

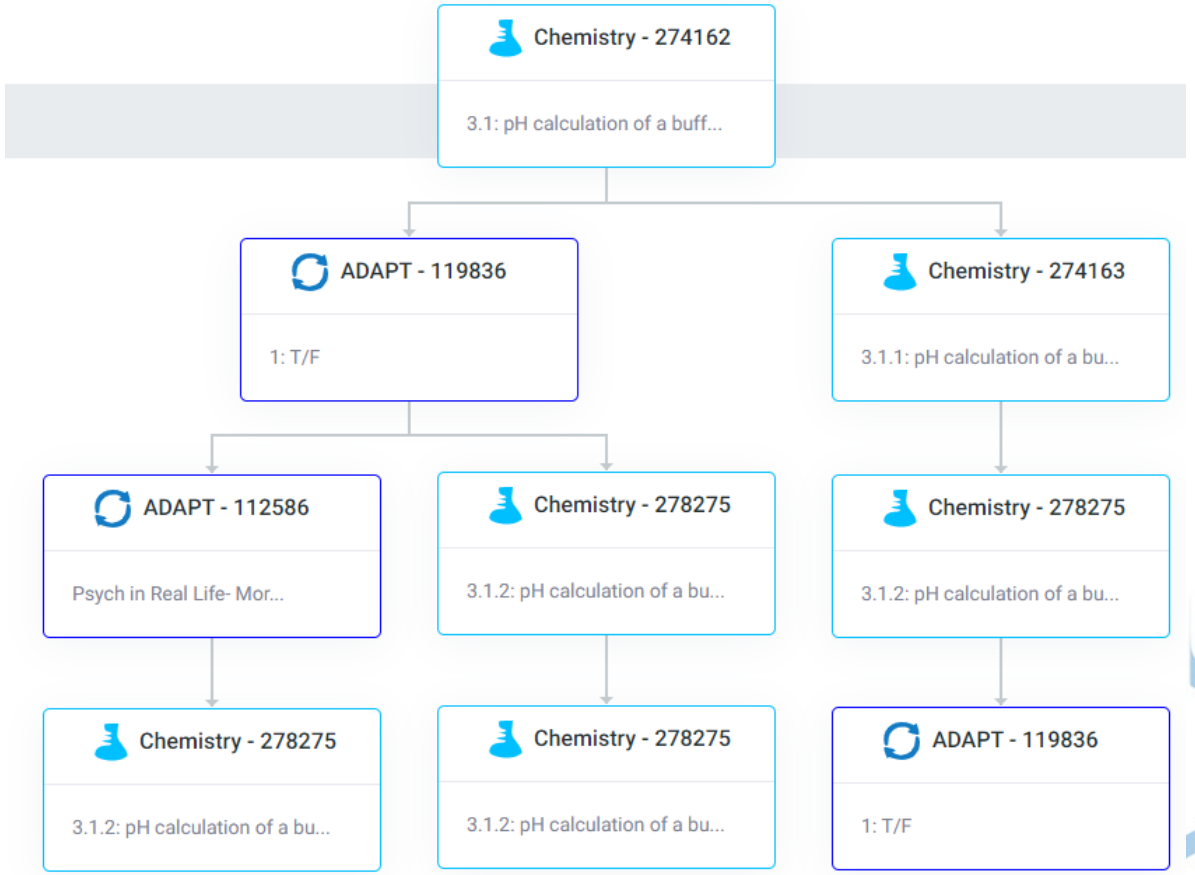
Useful for labs and collaborative projects (e.g., easy submission of pictures of collective or individual work)



ADAPT is Built for Multi-modal Use – Delivery

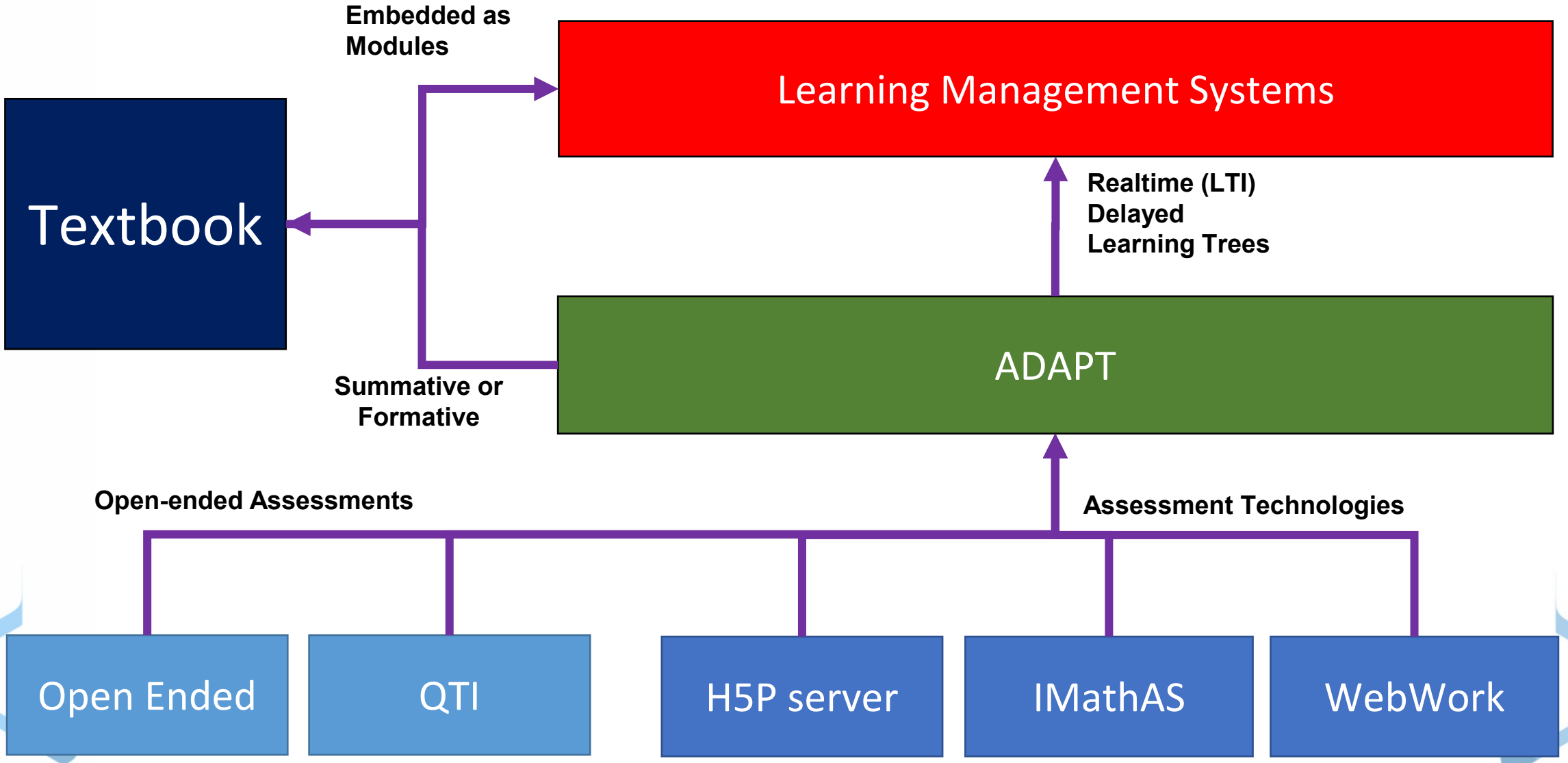
Students interact with problems via traditional Assignment/Question approach or via an adaptive Learning Tree approach that enables individualized assessment and learning.

☰ 🔒 Midterm 1 *	Yes	Midterm 1
☰ Midterm 1 (Corrected for Calculation)	Yes	Midterm 1
☰ 🔒 Midterm 2 *	Yes	Midterm 2
☰ Midterm 2 (Corrected for Calculation)	Yes	Midterm 2
☰ 🔒 Final Exam	No	Final
☰ 🔒 Exam Practice Problems *	Yes	Practice
☰ 🔒 Nomenclature Quiz *	Yes	Practice
☰ 🔒 Midterm 1 (Practice) 2010 *	Yes	Practice
☰ 🔒 Midterm 1 (Practice) 2012 *	Yes	Practice

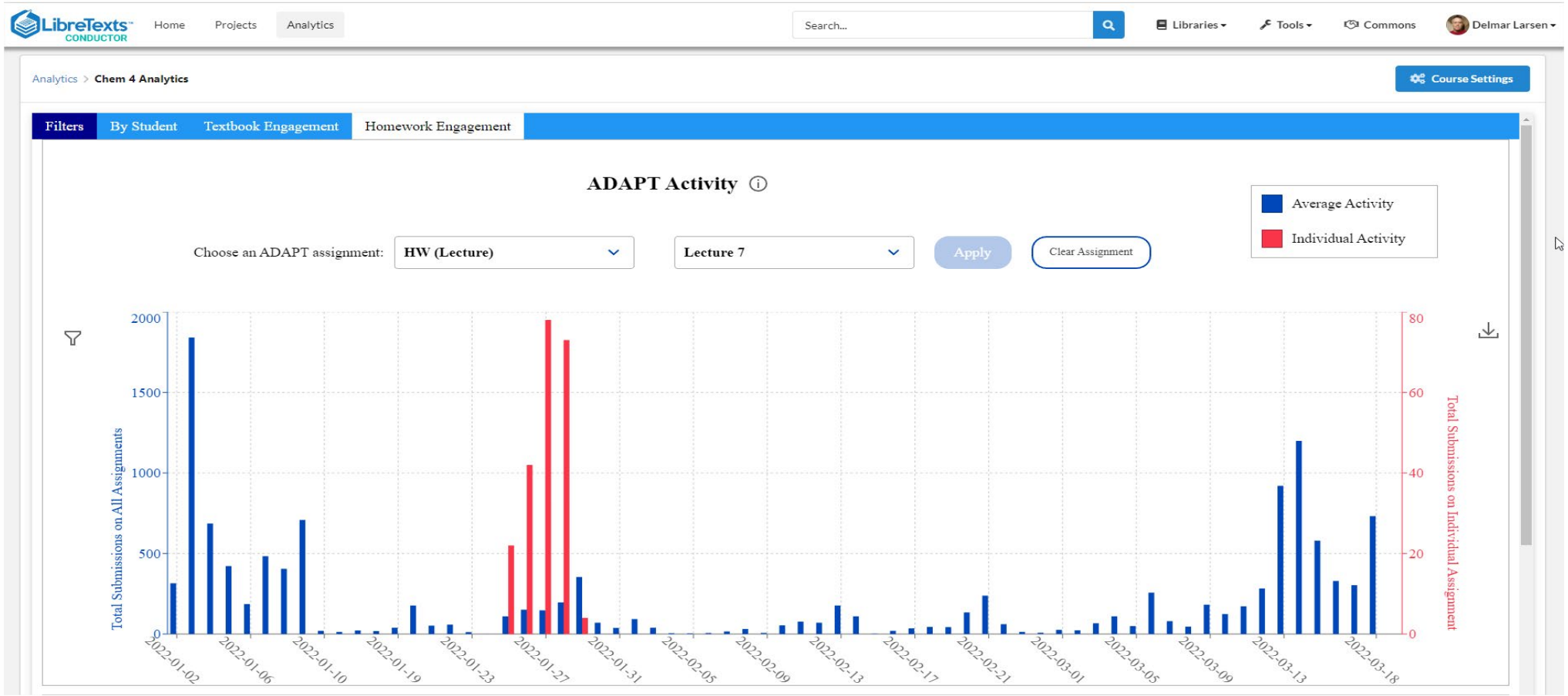


LibreTexts

Workflows



Learning Analytics – Data at your Fingertips



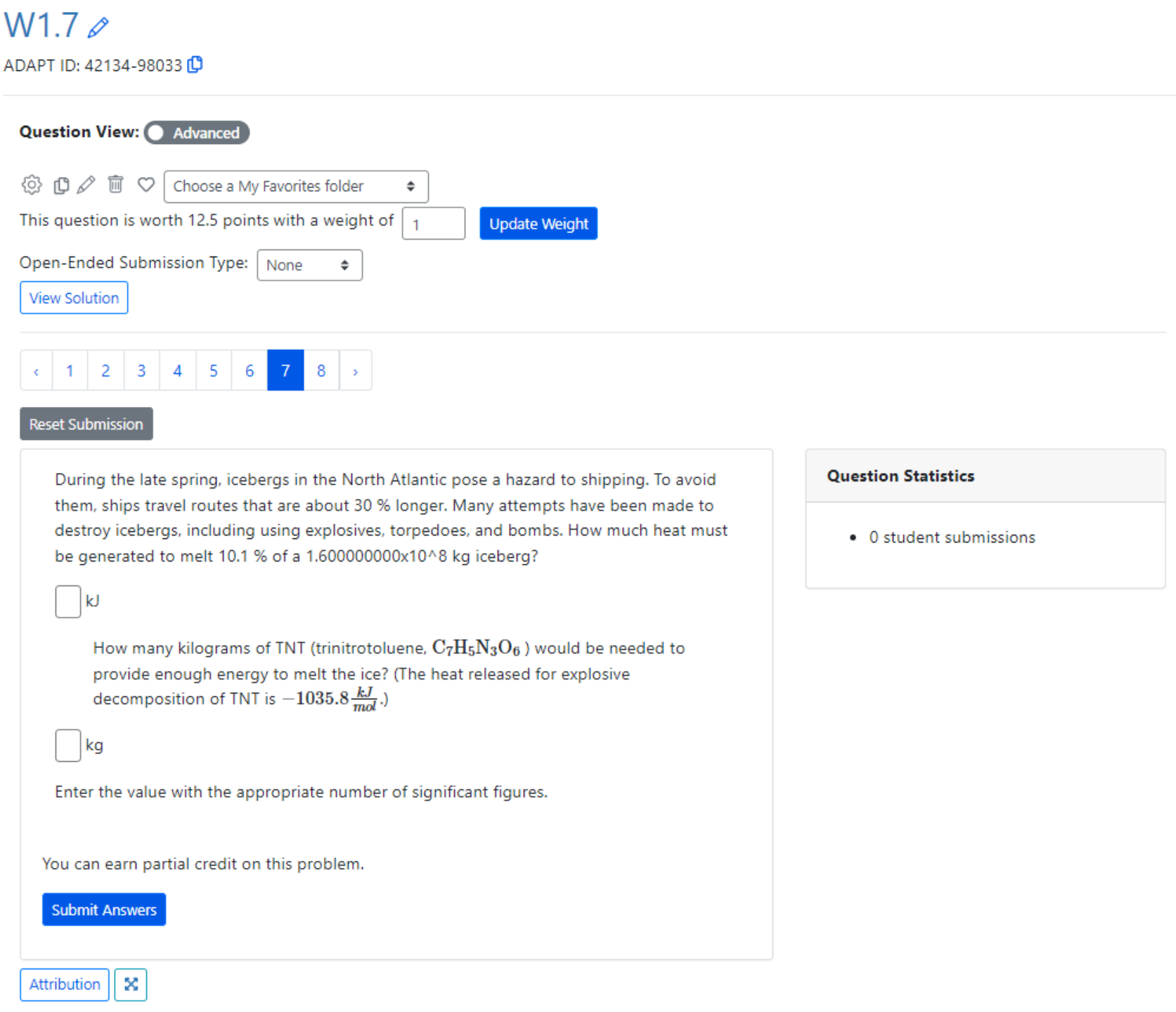
Snapshot of the homework activity for a class in the learning analytics dashboard showing the activity of all assignments (blue) and of a specific assignment (red).

LibreTexts

ADAPT in Action

Ideal question is …

- Autograd (if possible)
- Pedagogical Solution
- Algorithmic
- Significant Figures and precision
- Feedback (Mastering Approach)



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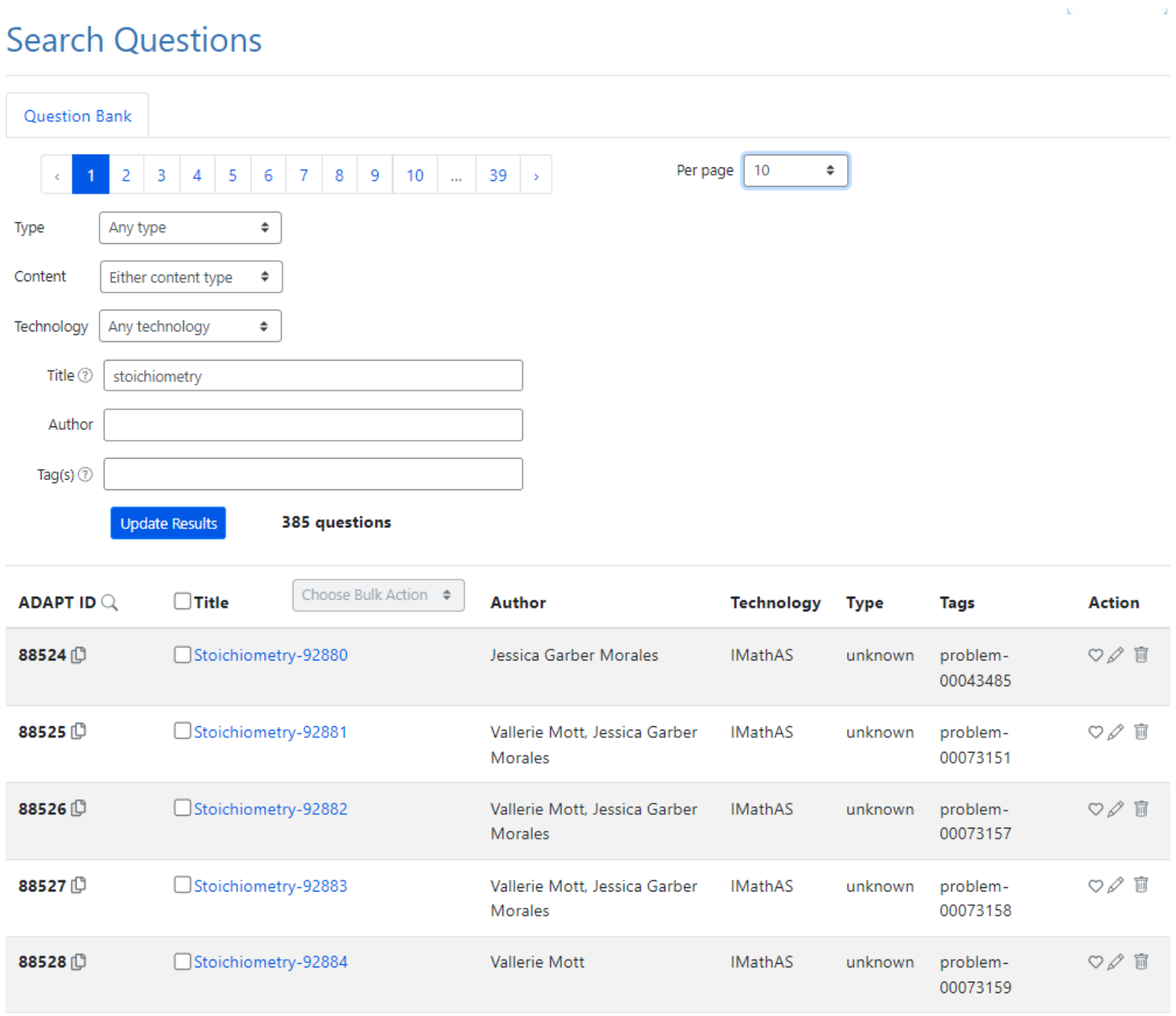
ADAPT in Action

Over 190,000 questions in the centralized question bank and **growing** rapidly



LibreTexts

ADAPT in Action

90 Premade Courses available in the Commons – mostly STEM.

250+ Public “Courses” available

Beginning Chemistry (Ball)	This text introductory chemistry text is aimed for a single semester or quarter beginning experience to the field. The textmaps survey some of the basic topics of chemistry. This survey should give student enough knowledge to appreciate the impact of chemistry in everyday life and, if necessary, prepare student for additional instruction in chemistry.
Big Ideas in Cosmology	Development of Big Ideas in Cosmology began with extensive research and vigorous peer review, to ensure the quality of the content and the level of instruction. Field testing was conducted at Sonoma State University to evaluate the effectiveness of the publication's methods and pedagogy, which revealed high levels of engagement and comprehension for science and non-science majors alike.
University Physics II (OpenStax)	University Physics is a three-volume collection that meets the scope and sequence requirements for two- and three-semester calculus-based physics courses. Volume 2 covers thermodynamics, electricity, and magnetism.
University Physics I (OpenStax)	University Physics is a three-volume collection that meets the scope and sequence requirements for two- and three-semester calculus-based physics courses. Volume 1 covers mechanics, sound, oscillations, and waves.
University Physics III (OpenStax)	University Physics is a three-volume collection that meets the scope and sequence requirements for two- and three-semester calculus-based physics courses. Volume 3 covers optics and modern physics.
General, Organic, and Biological Chemistry (Ball)	The Basics of General, Organic, and Biological Chemistry by David W. Ball, John W. Hill, and Rhonda J. Scott. This textbook is intended for the one-semester GOB course. Although a two-semester GOB sequence is available at many colleges and universities, one-semester GOB offerings are increasing in popularity. This textbook is divided into approximately one-half general chemistry topics, one-fourth organic chemistry topics, and one-fourth biochemistry topics.
Microbiology (OpenStax)	Microbiology covers the scope and sequence requirements for a single-semester microbiology course for non-majors. The book presents the core concepts of microbiology with a focus on applications for careers in allied health. The pedagogical features of the text make the material interesting and accessible while maintaining the career-application focus and scientific rigor inherent in the subject matter. Microbiology's art program enhances students' understanding of concepts through clear and effective illustrations, diagrams, and photographs.
General Biology (OpenStax)	Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy. Modern biology is a vast and eclectic field, composed of many branches and subdisciplines. However, despite the broad scope of biology, there are certain general and unifying concepts within it that govern all study and research, consolidating it into single, coherent fields. Subdisciplines of biology are defined by the scale at which organisms are studied, the kinds of organisms studied, and the methods used to study them.

LibreTexts

https://adapt.libretexts.org/open-courses/commons

ADAPT in Action

174 Learning Trees (mostly in General Chemistry)

Browse Learning Trees

‹ 1 2 3 4 ›

Per page 50

Full or partial-text matches will be counted when searching below.

Title

Author

Update Results

174 learning trees

ID	Title	Author
8	Gravitational Energy Question	Delmar Larsen
13	Identifying Significant Figures	Andreas Beyersdorf
22	Rounding Significant Figures	Andreas Beyersdorf
23	Significant Figures Calculations (Addition/Subtraction)	Andreas Beyersdorf
24	Significant Figures Calculations (Multiplication/Division)	Andreas Beyersdorf
25	Metric Conversion Basics	Andreas Beyersdorf
29	Molarity	Larry Mink
30	Dilution (154)	Larry Mink
31	Stoichiometry grams to grams (196)	Larry Mink
32	Stoichiometry and Limiting Reagent (197)	Larry Mink
33	Determination of molarity by titration (198)	Larry Mink
34	Combustion Analysis and Empirical Formula (273)	Larry Mink

[No Title]

LibreTexts

The Future of ADAPT

Development Goal: Building Quantity and Quality

Expanding Scope into other STEM fields:

- Physics,
- Engineering,
- Biology,
- Applied Health
- Mathematics,
- Statistics

Expand technology

- Juypter Tech for statistic and data sciences
- Greater Analytics
- Field specific Technology (e.g., organic chemistry, spreadsheets for statistics, virtual dissection)

Engaging Students as Scientists Through Authentic Research Inquiry

Sonal Singhal

on behalf of our CSU Dominguez Hills, El Camino College & UC Irvine team

Associate Professor // CSU Dominguez Hills

Who are we: CSU Dominguez Hills, El Camino College, UC Irvine

CSU Dominguez Hills
Carson, CA

- Regional comprehensive university
- Predominantly undergraduate institution
- 77% underrepresented minority
- 48% first-generation

El Camino College
Torrance, CA

- California Community College
- Offers Associate degrees as terminal degree
- 72% underrepresented minority
- 51% first-generation

UC Irvine
Irvine, CA

- Part of University of California system
- R1 university
- 33% underrepresented minority
- 50% first-generation

Our team at CSU Dominguez Hills, El Camino College, UC Irvine

Brynn Heckel
CSUDH

Sam Leigh
CSUDH

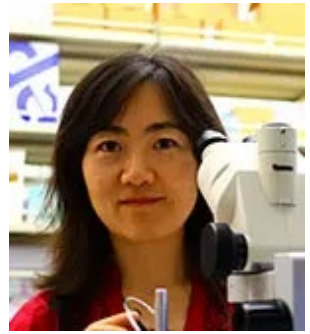
Karin Kram
CSUDH

Charlie McCord
CSUDH

Sonal Singhal
CSUDH

Kathryn Theiss
CSUDH

Justin Valliere
CSUDH



Fang Wang
CSUDH

Darcie McClelland
El Camino

Polly Parks
El Camino

Karla Villatoro
El Camino

Rachael Barry
UC Irvine

Suzanne Bohlson
UC Irvine

Brian Sato
UC Irvine

Lauren Snow
UC Irvine

not pictured: Bryan Carey (El Camino College), Nancy Roback (CSUDH), Carolyn Yarnall (CSUDH)

Our project goal was to provide inquiry-based experiences for biology students across our 3 campuses.

What was our approach?

Our starting point was cookbook labs

serves 8

sunday PASTA

The time it takes your *nonna* to make her Sunday pasta sauce is admirable. But let's face it, she's going to take that recipe to her grave. So why not bring together all of the best elements of the Italian combo sub, toss them into a pot, and then throw the fact that you don't need her recipe into your *nonna's* face! Wait, don't do that . . . your *nonna* is amazing and lovely and kind (but she's still never going to give you that recipe).

- ½ lb (250 g) sopressata, cut into 1-inch (2.5-cm) dice
- ½ lb (250 g) dry-cured ham or prosciutto (not thinly sliced), cut into 1-inch (2.5-cm) dice
- ½ lb pepperoni (not thinly sliced), cut into 1-inch (2.5-cm) dice
- ¼ cup (2 fl oz/60 ml) extra-virgin olive oil, plus 2 Tbsp
- 2 garlic cloves
- 2 cups (10 oz/315 g) finely diced carrot
- 2 cups (10 oz/315 g) finely diced yellow onion
- 2 cups (10 oz/315 g) finely diced celery
- Kosher salt
- ½ lb (250 g) ground pork
- 1 cup (8 oz/250 g) tomato paste
- 4 fresh thyme sprigs
- 2 bay leaves
- 1 can (16 oz/500 g) crushed San Marzano or other good-quality tomatoes
- 3 cups (24 fl oz/750 ml) chicken stock
- 1 cup (8 fl oz/250 ml) dry white wine
- 1 tsp red pepper flakes, or more to taste
- 1 lb (500 g) large rigatoni
- 1 Tbsp unsalted butter
- ¾ cup (3 oz/90 g) grated aged provolone cheese
- ¼ lb (125 g) baby arugula
- 1 Tbsp aged balsamic vinegar
- ½ cup (2½ oz/75 g) sliced peperoncini

In a food processor, combine the sopressata, ham, and pepperoni and pulse until a coarse paste forms. Set aside.

In a large pot, heat the ¼ cup (2 fl oz/60 ml) olive oil over medium heat. Add the garlic, carrot, onion, celery, and 1 teaspoon salt. Reduce the heat to low, cover, and simmer, stirring regularly, until the vegetables are very soft, about 1 hour. Do not allow them to darken in color or burn.

Add the pork and the ground meat mixture, raise the heat to medium, and simmer, stirring often to prevent burning, for 30 minutes. Add the tomato paste, thyme, and bay leaves and reduce the heat to low. Stir in the crushed tomatoes and cook, stirring often, for 10 minutes. Add the stock, wine, and red pepper flakes and simmer, stirring occasionally to prevent sticking, until thick, about 30 minutes. Remove and discard the bay leaves.

When the sauce is almost done, bring a large pot of salted water to a boil over high heat. Add the pasta and cook for 1 minute less than the package directions for al dente. Drain the pasta (do not rinse) and reserve 1 cup (8 fl oz/250 ml) of the cooking water.

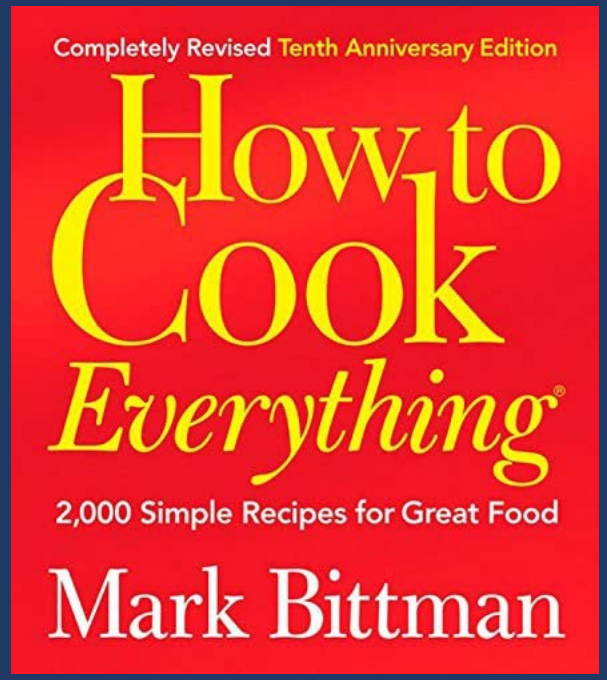
Return the pasta to the cooking pot and add the sauce, ½ cup (4 fl oz/125 ml) of the reserved cooking water, the butter, and half of the cheese. Place the pot over medium heat and heat, stirring, until the pasta is well coated with the sauce; if the pasta is dry, add more cooking water.

Transfer the pasta to a large serving platter. In a small bowl, mix together the arugula, the 2 tablespoons olive oil, the vinegar, the peperoncini, and the remaining cheese. Garnish the pasta with the arugula mixture and serve right away.

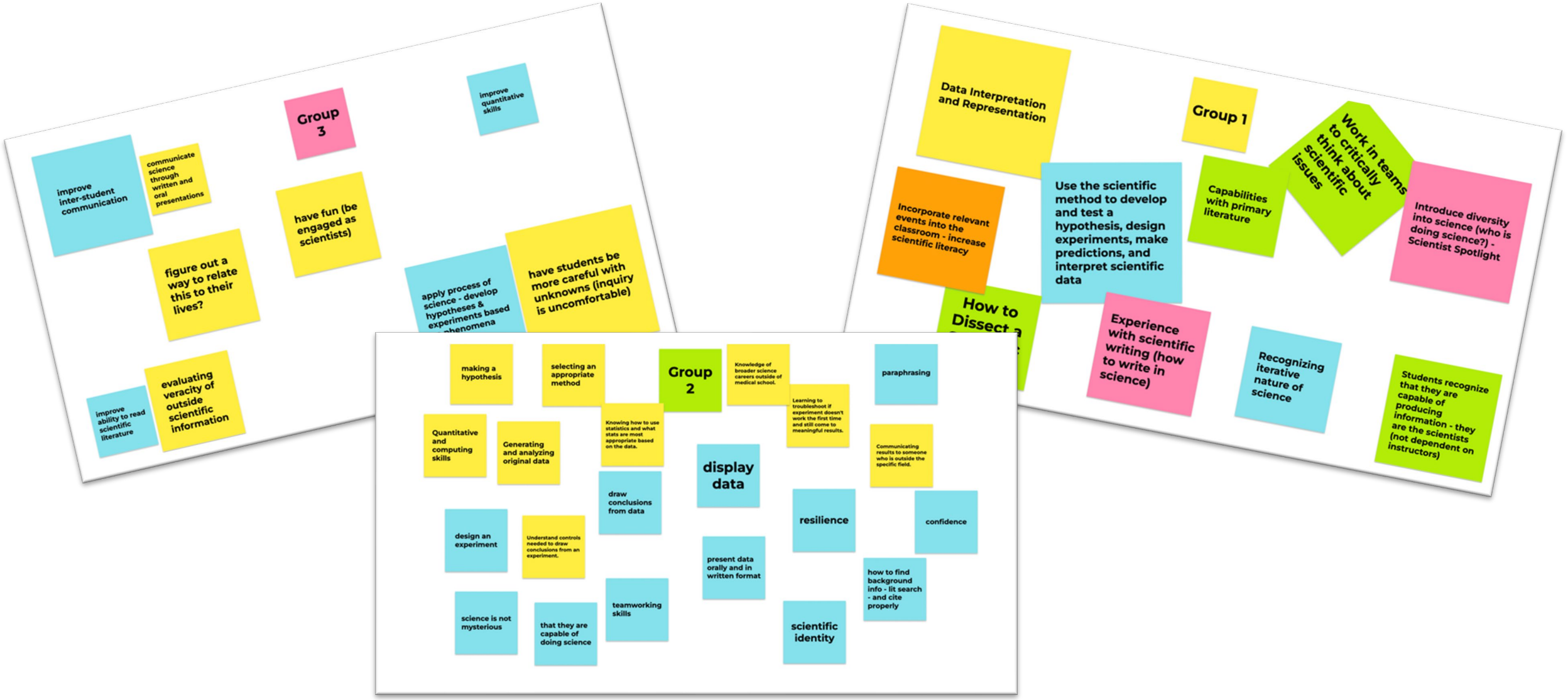
34

https://www.eater.com/2015/3/16/8225163/classic-recipes-for-modern-people-chef-brothers-max-eli-sussman-cookbook

How do we go from here to there?



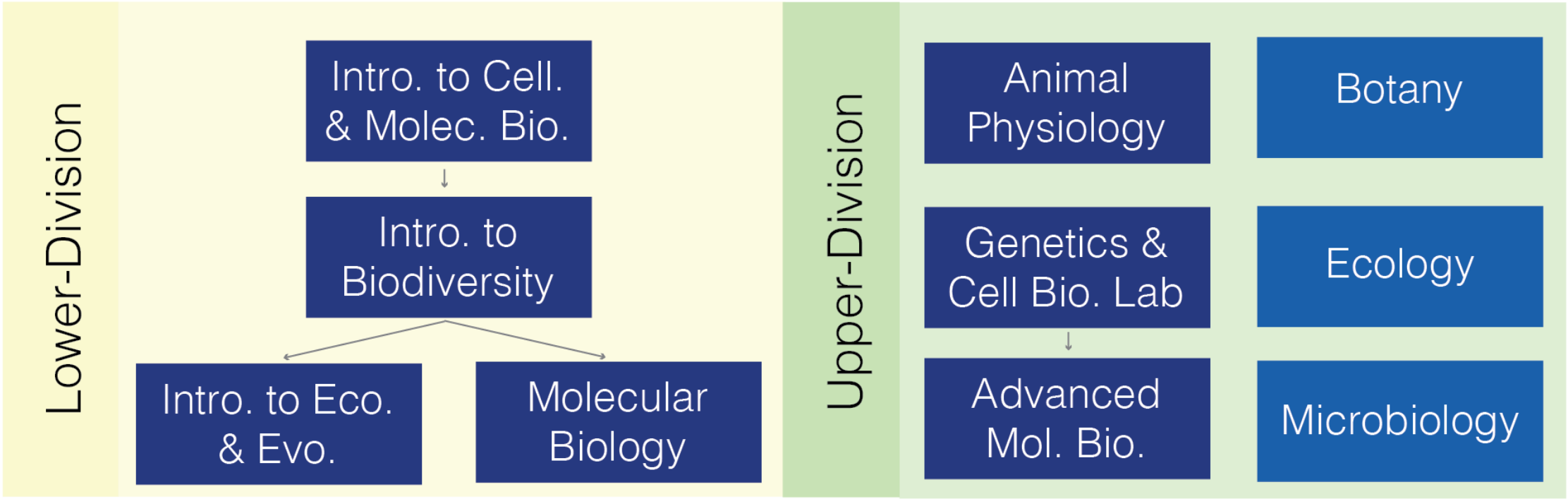
Collaborative design of learning objectives



Our final learning objectives

- Engage with the tenets of the scientific method
- Communicate effectively
- Work effectively in a team of their peers.
- Recognize the diversity of participants within the scientific community.
- Effectively use quantitative skills to address scientific questions.

Curriculum structure provided natural scaffolding



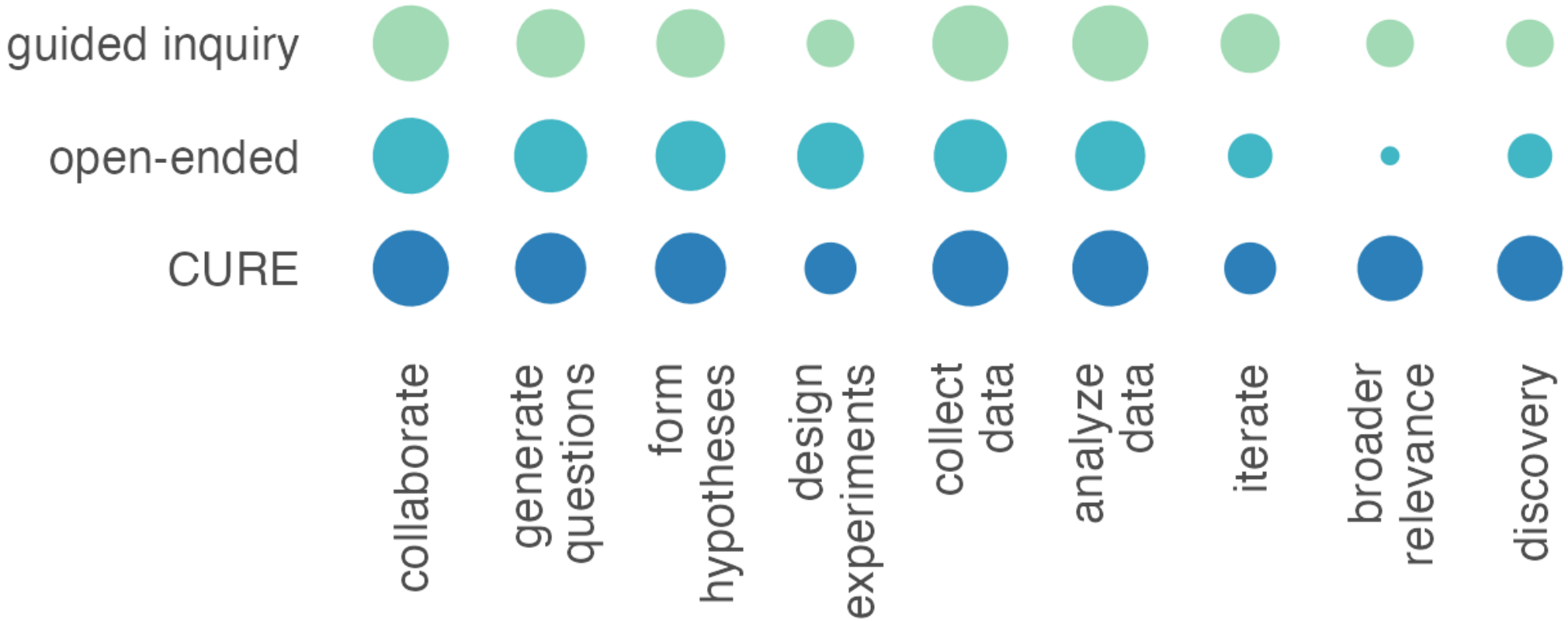
Collaborative design of content and skill scaffolding

course	Scientific citation	Scientific literature	Lab reports	Figure / table generation	Lab presentation	teamwork	statistics	Hypothesis generation
Bio 121	Parts of a citation	Primary v secondary and trustworthiness	Writing figure legend Writing methods (I find that the easiest)?	Identify dependent & independent variable Make box plot and/or line graph (log scale?)	What should a presentation contain?		Simple t-test	Difference between question and hypothesis Hypothesis should have a direction
Bio 123	Create a literature-cited page in proper CSE format	Finding scholarly sources, reading scientific literature, and evaluating the quality of various types of literature	What is plagiarism and how to avoid it paraphrasing	Make a histogram, understand why/how bar graphs can be misleading; be able to explain relationships among variables	Presentation skills; focus on the skeleton of solid presentations and press into how to make the science presenting better	Goal setting for individual and group norms, expectations, etc at start of term; end of term reflection of teamwork	Descriptive stats; t-test; chi-square	Difference between statistical and biological hypotheses; difference between hypotheses and predictions
Bio 125	How to use a citation manager (Zotero)	How to break down figures	Writing introduction	Making histogram Making tables	What does an effective slide look like?	How to use collaborative tools to help facilitate group work	ANOVAs? Or correlations?	Null vs alternate hypotheses
Bio 221	Find a relevant paper and cite it	Describe a figure from a paper to the class	Create a report with embedded figures and reference them.	Create graph from spreadsheet with axes labeled and a sound legend.	Describe a figure from a paper to the class	Lab groups.		Question vs. hypothesis vs. prediction. Was the hypothesis supported by the data?
Upper div bio courses	Use multiple primary sources for a report and cite them	Describe multiple figures from a paper to the class	Deeper focus on scientific language	Multi-panel figure	Full-story presentation			

This project touched a lot of students.

Institution	Number of courses	Students per course (per semester)	Total students across courses (per year)
CSU Dominguez Hills	10	~40	~500
El Camino College	4	~40	~300
UC Irvine	2	~1500	~3000

Our learning objectives were implemented across a diversity of inquiry-based experiences



An example of a guided inquiry: Bio Sci 93 @ UC Irvine

Rachael Barry
UC Irvine

An example of a guided inquiry: Bio Sci 93 @ UC Irvine

Maria, Metastasis, and Methotrexate

- A case-study centered on cancer biology
- This case study was designed to have students:
  - Apply their knowledge re: the cell cycle
  - Interpret data and figures from primary scientific literature
  - Explore the contributions of scientists from marginalized backgrounds

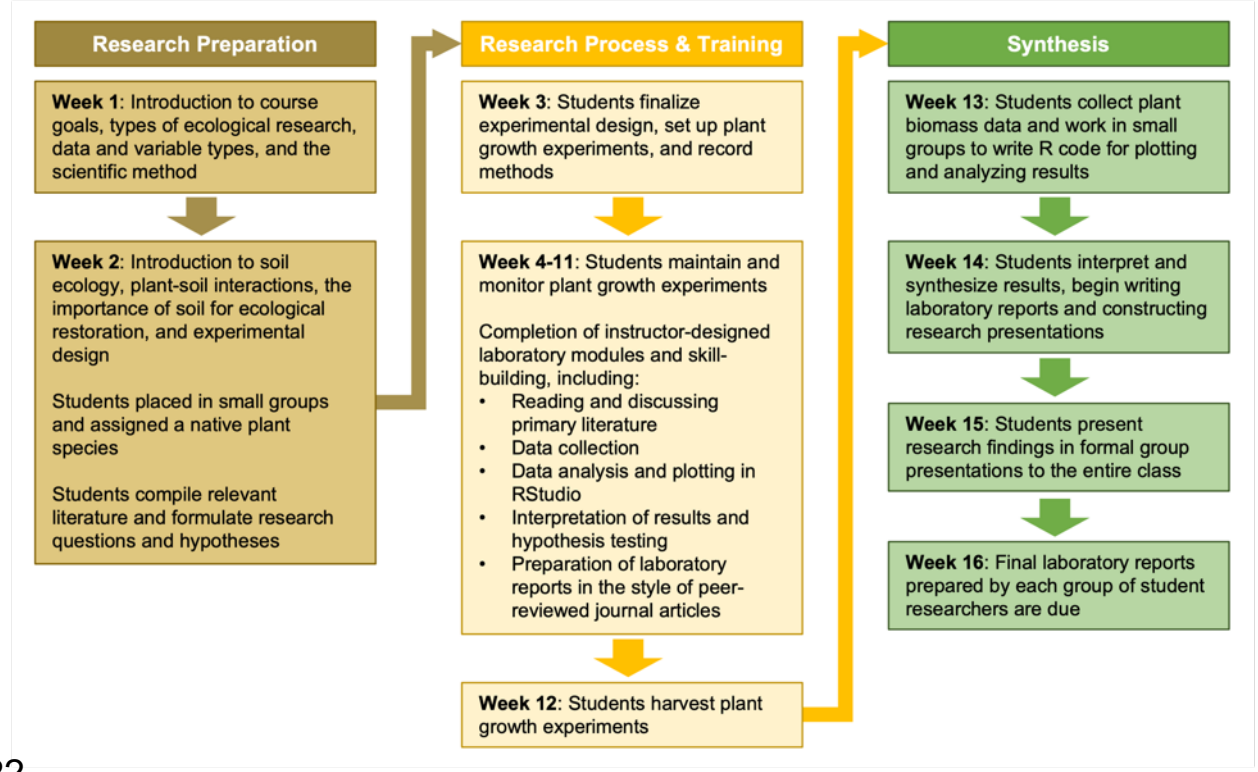
Jewel Plummer Cobb
MTX in treatment of childhood cancers

Jane Cooke Wright
MTX in treatment of solid tumors

https://www.nsta.org/ncss-case-study/maria-metastasis-and-methotrexate

An example of a CURE: BIO 333 @ CSUDH

- Students develop a research question on the role of soils in plant growth

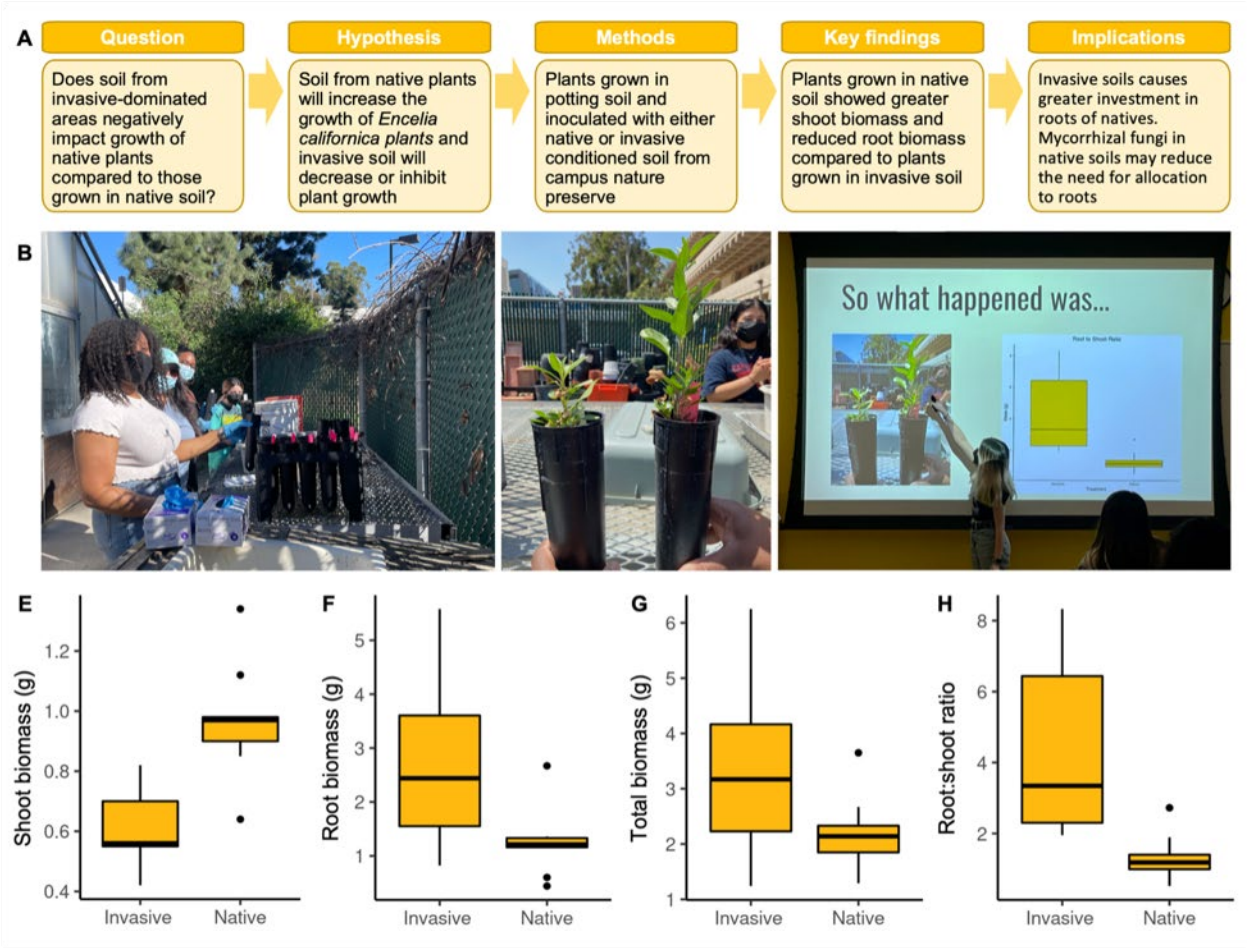


Justin Valliere
CSUDH
(now UC Davis)

Valliere 2022

An example of a CURE: BIO 333 @ CSUDH

- This project is designed to have students
  - Develop research questions, hypotheses, and methods
  - Implement experiment with colleagues
  - Use R to analyze and graph data
  - Share results in standard scientific formats



Valliere 2022

So did it work?

How did we assess?

- Informal
  - Group discussions
- Formal
  - Student survey
  - Faculty survey
  - Retention in major (ongoing)

Our anecdata & faculty survey show many positives and some challenges

Benefits

- Students were more engaged
- More fun for students & faculty
- Easier to engage with students
- Lab staff liked the changes
- Labs were cheaper

Challenges

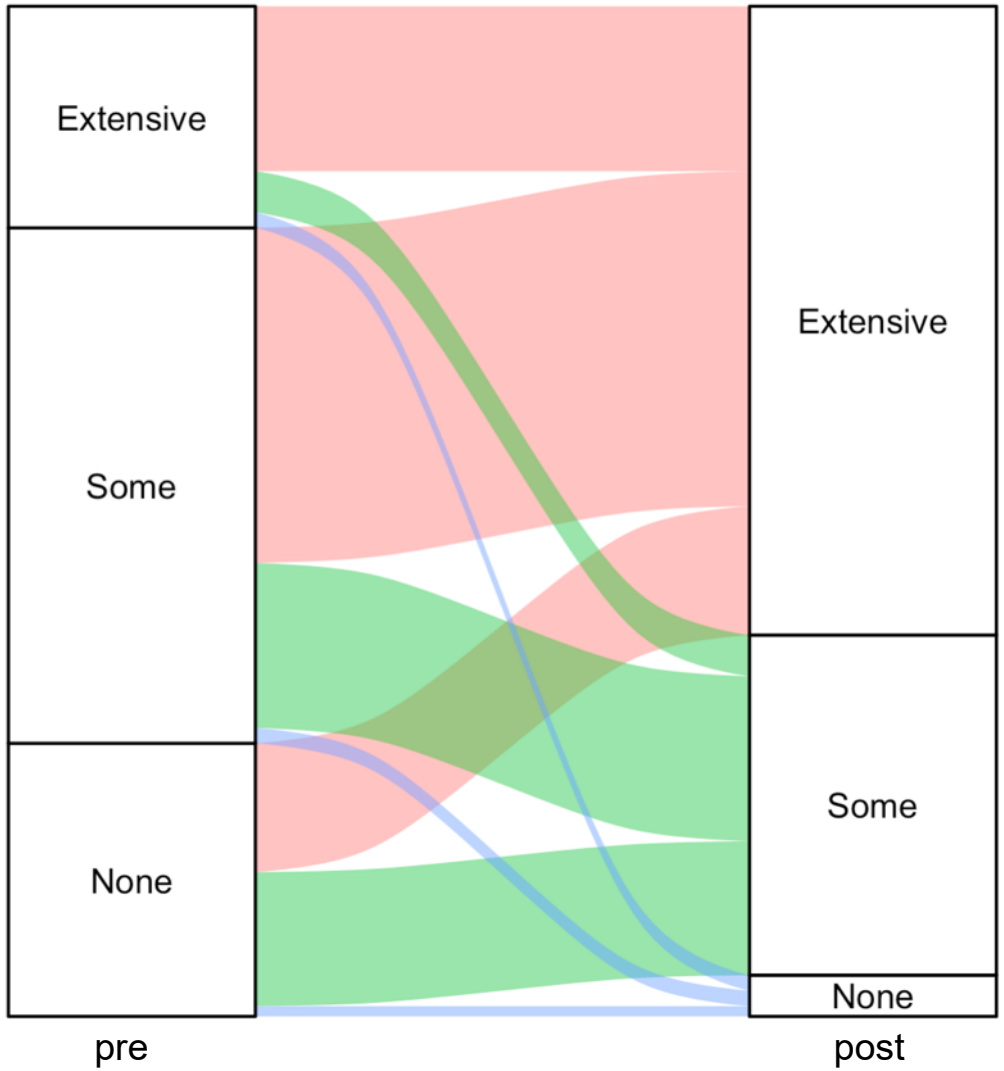
- Needed more examples of authentic inquiry labs
- More time-consuming
- Required more on-your-feet thinking
- Can be challenging to implement curriculum across sections (logistics, instructor buy-in)
- Did not work online
- Logistics non-trivial

How are we measuring success?

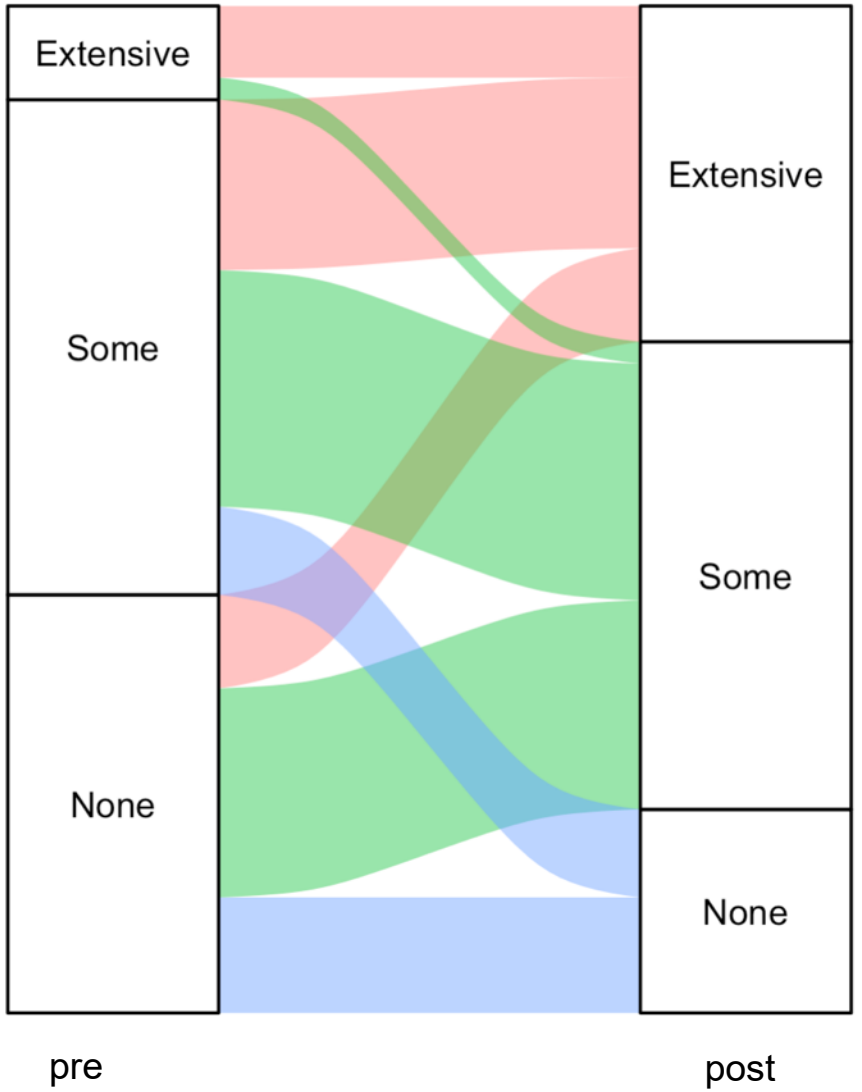
- Increasing student retention in the major
- Increasing student efficacy in their scientific abilities
  - Engage with the tenets of the scientific method
  - Communicate effectively
  - Effectively use quantitative skills to address scientific questions
- Increasing student sense of belonging in the major
  - Work effectively in a team of their peers
  - Recognize the diversity of participants within the scientific community

Student outcomes improved!

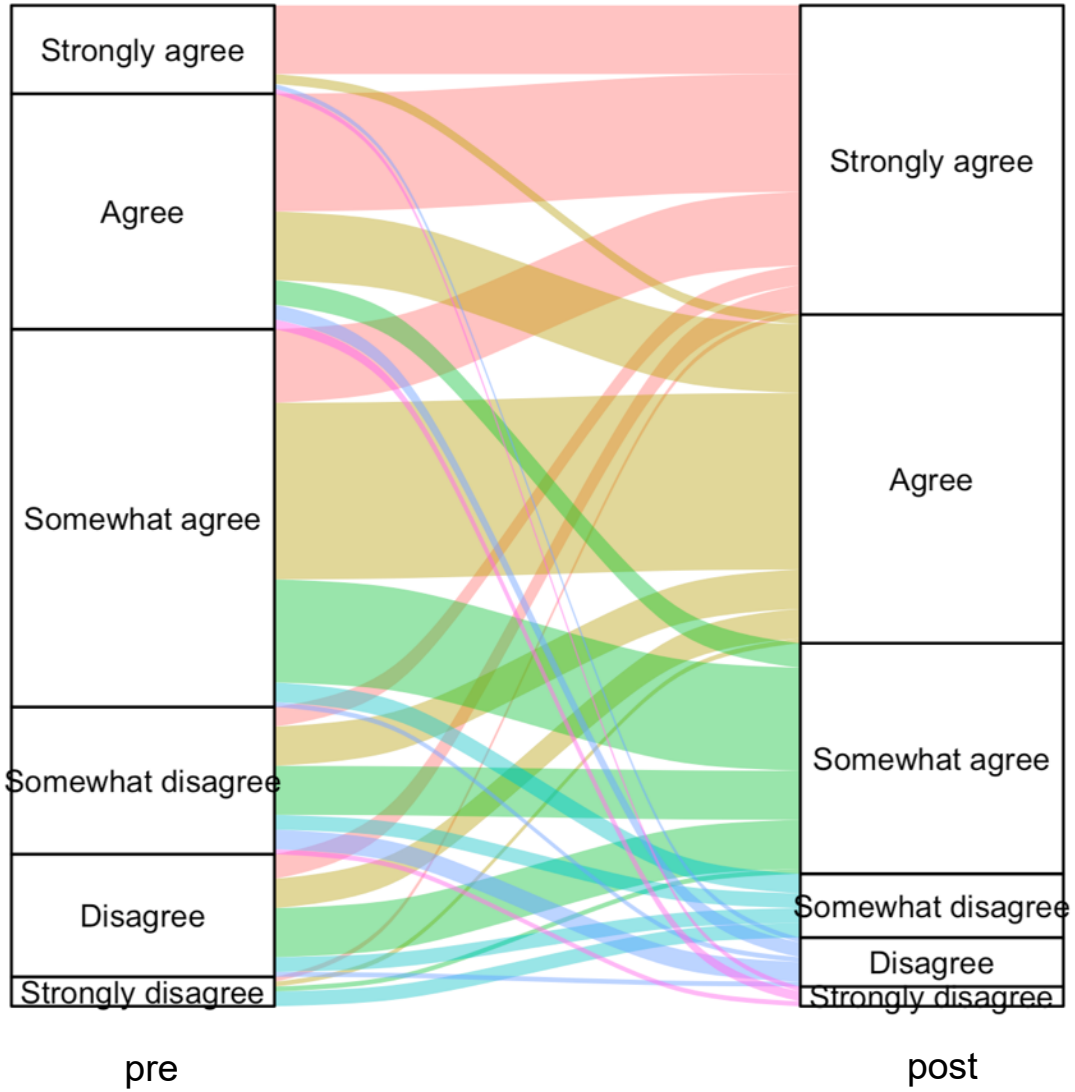
Engage with the tenets of the scientific method: Level of experience with an independent research project



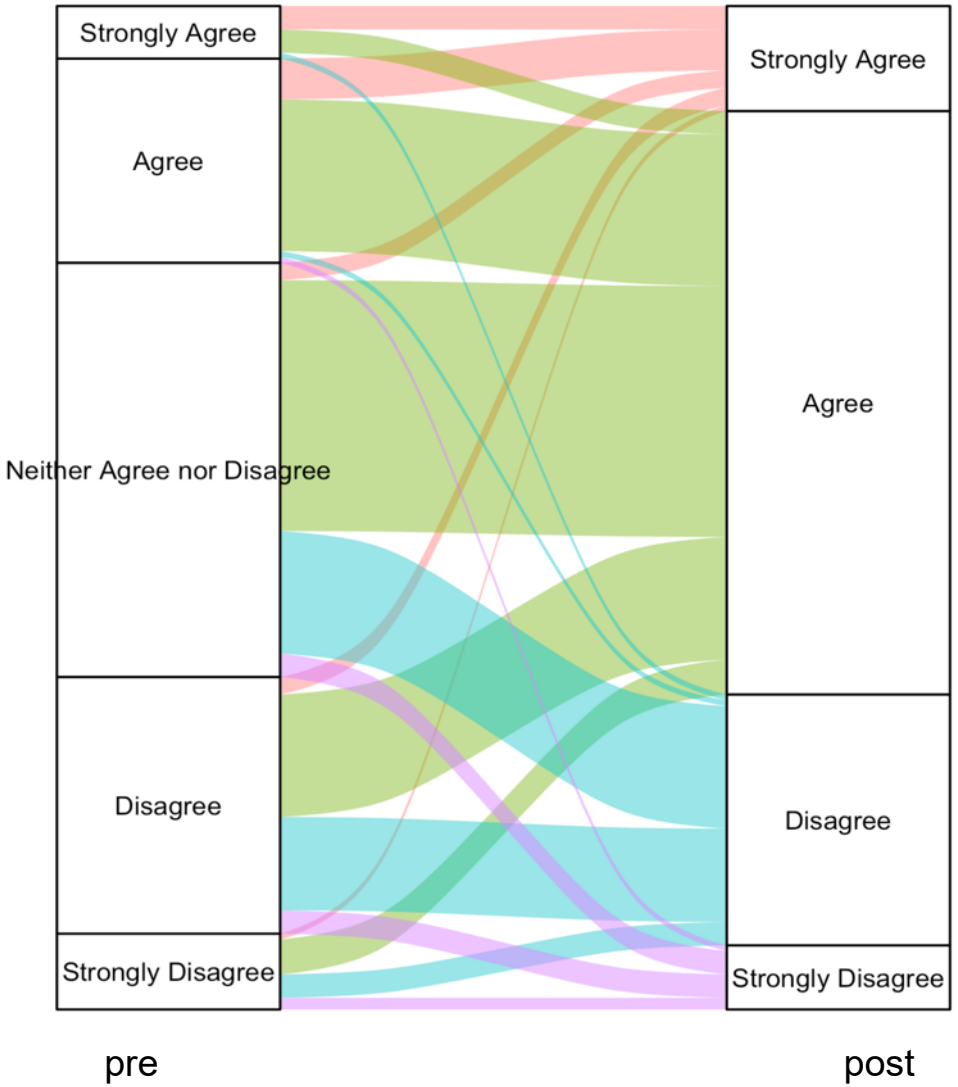
Communicate effectively:
Level of experience with writing a research proposal



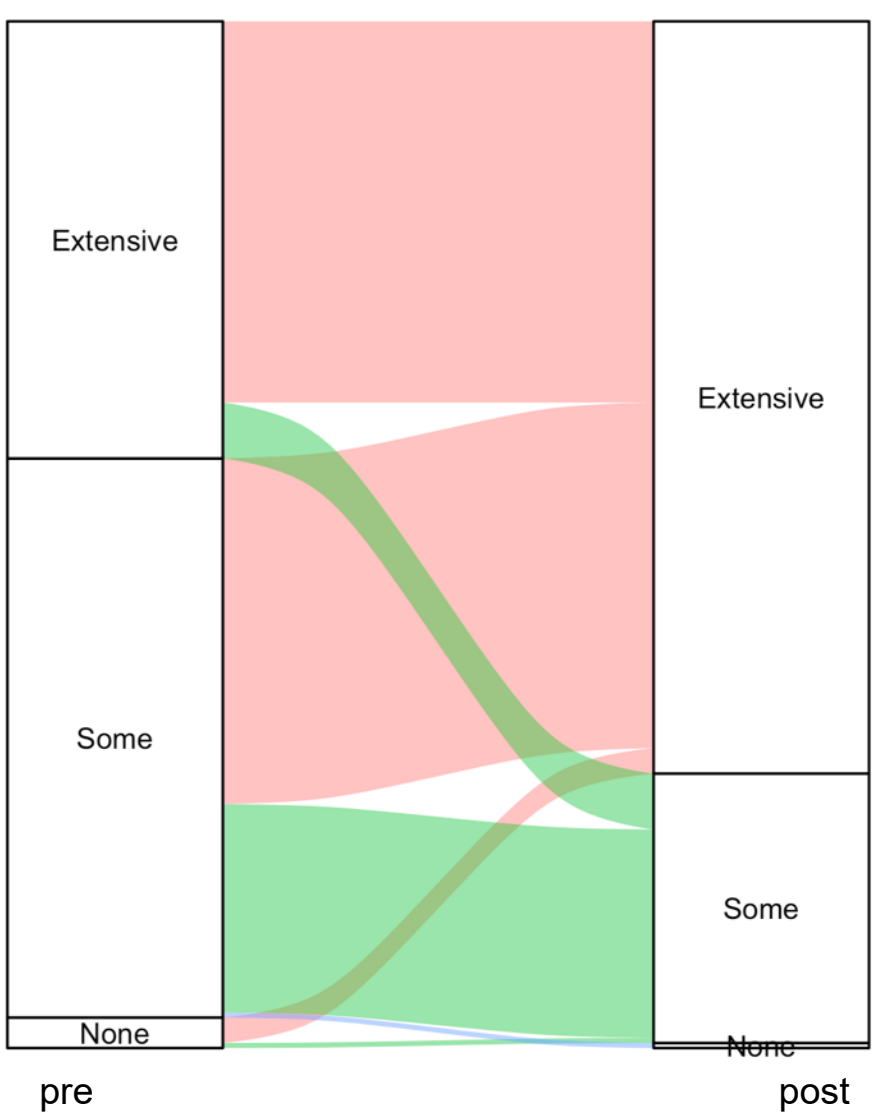
Work effectively in a group of your peers:
The people near me have learned from me



Recognize the diversity of scientists in our community:
I know of one or more scientists with whom I can personally relate



Effectively use quantitative skills to address scientific questions.: Level of experience with analyzing data



Where to next?

Acknowledgements

- Our grant participants
- Our faculty and staff at each institution
- Our funders, CA Learning Lab

For questions, please contact:

Sonal Singhal

ssinghal@csudh.edu

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- https://www.theguardian.com/science/2013/sep/15/zebrafish-human-genes-project
- https://news.csudh.edu/overall-mobility/
- https://www.livescience.com/33907-sea-monkeys.html

Questions ???

On-ramp to STEM

The key to success in STEM is empowering all students to take ownership of their learning.

project website: bit.ly/onramptostem

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Bianca Lopez Yendluri, Lecturer
Cal State Fresno, Department of Mathematics
byendluri@mail.fresnostate.edu

Motivation

- For many students, **College Algebra** and **Precalculus** are a roadblock to a STEM degree.
  - Low passing rates
  - Lack of conceptual understanding
  - Lack of confidence and negative mindsets
  - Unprepared for subsequent math courses
  - Large learning/achievement gap for URM students

On-Ramp to STEM project

- ***Goal #1***: ***Transform the culture of learning*** in math classrooms
- ***Goal #2***: Develop and utilize suitable ***Adaptive Learning Technology*** and appropriate pedagogy to assist students of all backgrounds.
- ***Goal #3***: Improve the learning outcomes and ***close the achievement gaps*** among student populations

Impacted courses (~1000 students)

Fall 2022

- 11 Precalculus classes at Fresno State
- 2 Precalculus classes at Clovis Community College
- 4 College Algebra classes at Fresno City College
- 1 Advanced math class at University High School

Spring 2023

- 8 Precalculus classes at Fresno State
- 3 classes (2 Precalculus/1 College Algebra) at Clovis Community College
- 2 College Algebra classes at Fresno City College
- 1 Advanced math class at University High School

Summer 2023

- 1 Precalculus class at Fresno State

Fall 2023

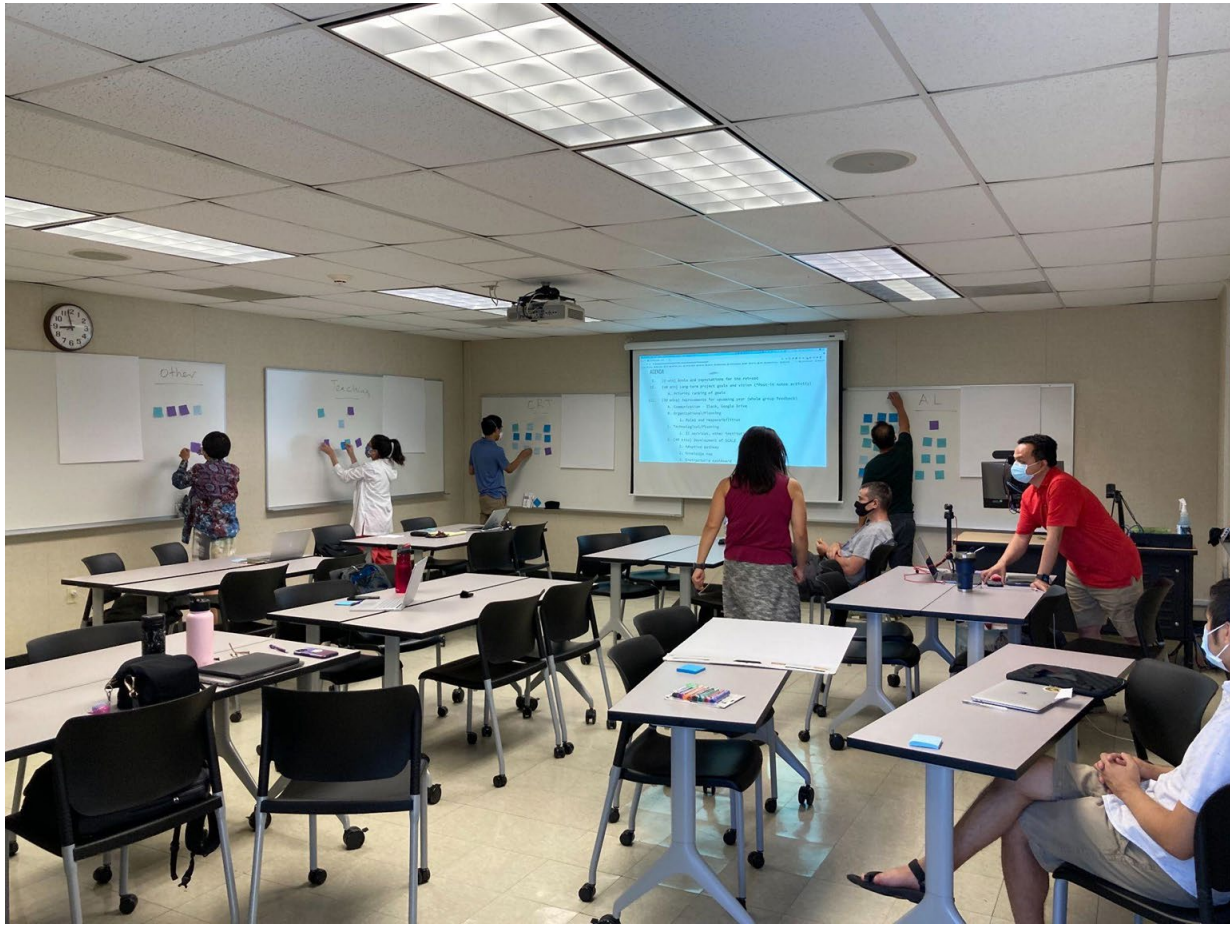
- 10 Precalculus classes at Fresno State
- 1 College Algebra class at Clovis Community College
- 3 College Algebra classes at Fresno City College

Engage instructors in Culturally Responsive Teaching

- Summer Workshops
  - Invited experts in Culturally Responsive Teaching (CRT) pedagogies
- Check-in meetings with instructors during the year
- Peer observations/feedback
- Shared resources - CRT implementation journal

New Classroom for PreCalc at Fresno State

- Dedicated classroom for precalculus courses at Fresno State.
- Whiteboards around the room and tables and chairs to promote active learning, collaborations and discourse.



SCALE (Student-Centered Adaptive Learning Environment)

- *"A platform for delivering adaptive instruction online, and provides a framework that **guides the learner** through the instructional content based on proven theories about how people learn effectively."*
  - Dr. Bill Ferster, University of Virginia.

SCOOL (Student-Centered Open Online Learning)

- Developed by **Dr. Cecotti and students** of Fresno State Computer Science.

- To guide students through the learning process
  - **Formative** and **summative** assessments
  - Homework or extra credit assignments
  - Independent and autonomous learning

- Integrated through CANVAS LMS API

Knowledge map

- Knowledge map: A hierarchical concept map of learning outcomes.
  - Created by team of expert Math instructors.
  - Learning outcomes derived from **OpenStax textbook**.
  - Connected ~**220 learning outcomes** from College Algebra and Precalculus.

- Feedback to the user
  - *If you master a learning outcome, what is next?*
  - *If you have problems with activities related to a given learning outcome, what prerequisite learning outcomes were not met?*

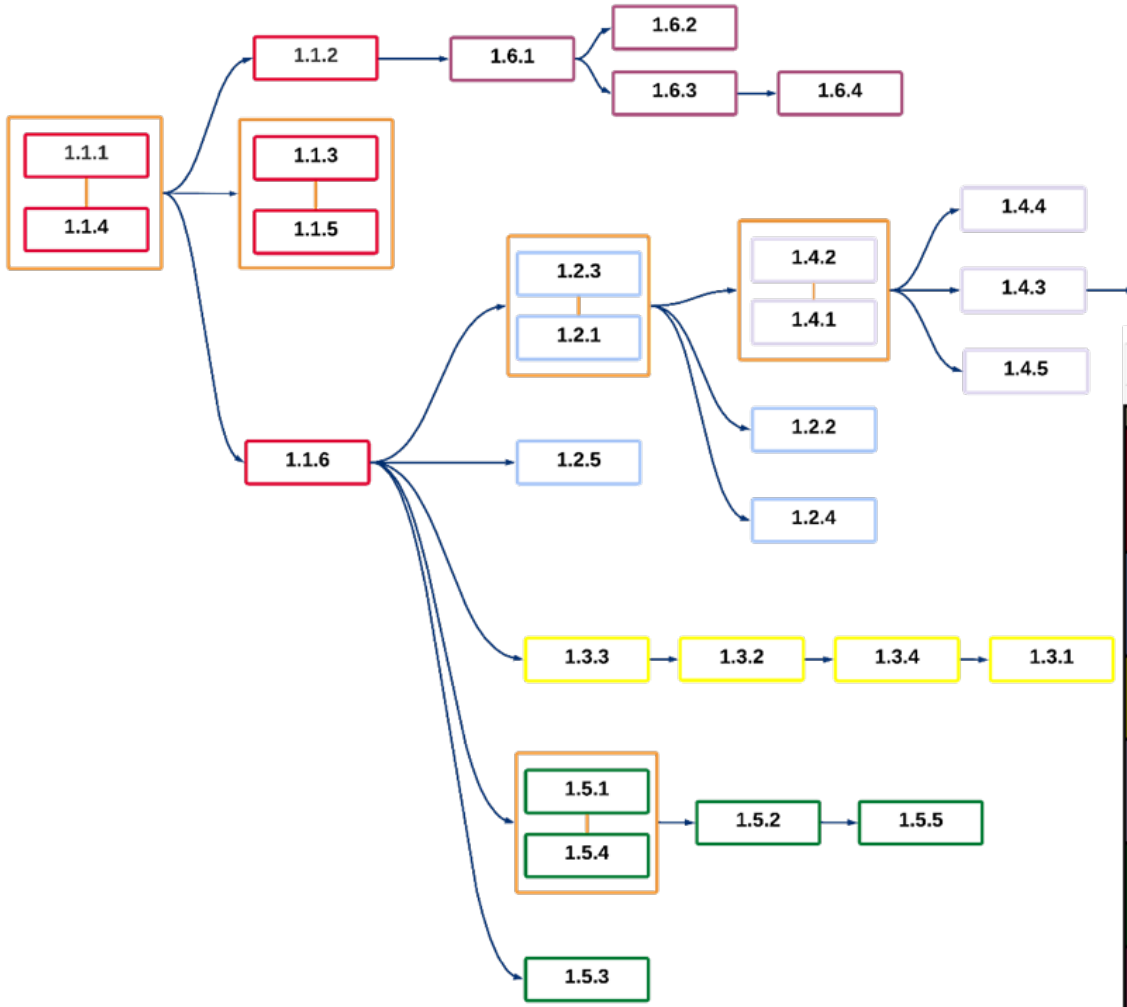
- Empower students to build and improve on prerequisite skills.

- Enable instructors to identify roadblocks in learning pathways.

Chapter 1 Learning Outcomes

	Section	LO #	Section Title	Learning Outcome
	1.1	1.1.1	Functions and Function Notation	Determining Whether a Relation Represents a Function
	1.1	1.1.2	Functions and Function Notation	Finding Input and Output Values of a Function
	1.1	1.1.3	Functions and Function Notation	Determining Whether a Function is One-to-One
	1.1	1.1.4	Functions and Function Notation	Using the Vertical Line Test
	1.1	1.1.5	Functions and Function Notation	Using the Horizontal Line Test
	1.1	1.1.6	Functions and Function Notation	Identifying Basic Toolkit Functions
	1.2	1.2.1	Domain and Range	Finding the Domain of a Function Defined by an Equation
	1.2	1.2.2	Domain and Range	Using Notations to Specify Domain and Range
	1.2	1.2.3	Domain and Range	Finding Domain and Range from Graphs
	1.2	1.2.4	Domain and Range	Finding Domains and Ranges of the Toolkit Functions
	1.2	1.2.5	Domain and Range	Graphing Piecewise-Defined Functions
	1.3	1.3.1	Rates of Change and Behavior of Graphs	Finding the Average Rate of Change of a Function
	1.3	1.3.2	Rates of Change and Behavior of Graphs	Using a Graph to Determine Where a Function is Inc, Dec, or Const
	1.3	1.3.3	Rates of Change and Behavior of Graphs	Analyze the Toolkit Functions for Increasing or Decreasing Intervals
	1.3	1.3.4	Rates of Change and Behavior of Graphs	Use A Graph to Locate the Absolute Maximum and Absolute Minimum
	1.4	1.4.1	Composition of Functions	Combining Functions Using Algebraic Operations
	1.4	1.4.2	Composition of Functions	Create a Function by Composition of Functions
	1.4	1.4.3	Composition of Functions	Evaluating Composite Functions
	1.4	1.4.4	Composition of Functions	Finding the Domain of a Composite Function
	1.4	1.4.5	Composition of Functions	Decomposing a Composite Function into its Component Functions
	1.5	1.5.1	Transformation of Functions	Graphing Functions Using Vertical and Horizontal Shifts
	1.5	1.5.2	Transformation of Functions	Graphing Functions Using Reflections about the Axes
	1.5	1.5.3	Transformation of Functions	Determining Even and Odd Functions
	1.5	1.5.4	Transformation of Functions	Graphing Functions Using Stretches and Compressions
	1.5	1.5.5	Transformation of Functions	Performing a Sequence of Transformations
	1.6	1.6.1	Absolute Value Functions	Understanding Absolute Value
	1.6	1.6.2	Absolute Value Functions	Graphing an Absolute Value Function
	1.6	1.6.3	Absolute Value Functions	Solving an Absolute Value Equation
	1.6	1.6.4	Absolute Value Functions	Solving an Absolute Value Inequality
	1.7	1.7.1	Inverse Functions	Verifying That Two Functions Are Inverse Functions
	1.7	1.7.2	Inverse Functions	Finding Domain and Range of Inverse Functions
	1.7	1.7.3	Inverse Functions	Finding and Evaluating Inverse Functions
	1.7	1.7.4	Inverse Functions	Finding Inverse Functions and Their Graphs

Chapter 1 Knowledge map



PreCalculus Chapter 1 - Functions

Color	Section	LO #	Section Title	Learning Outcome
	1.1	1.1.1	Functions and Function Notation	Determining Whether a Relation Represents a Function
	1.1	1.1.2	Functions and Function Notation	Finding Input and Output Values of a Function
	1.1	1.1.3	Functions and Function Notation	Determining Whether a Function is One-to-One
	1.1	1.1.4	Functions and Function Notation	Using the Vertical Line Test
	1.1	1.1.5	Functions and Function Notation	Using the Horizontal Line Test
	1.1	1.1.6	Functions and Function Notation	Identifying Basic Toolkit Functions
	1.2	1.2.1	Domain and Range	Finding the Domain of a Function Defined by an Equation
	1.2	1.2.2	Domain and Range	Using Notations to Specify Domain and Range
	1.2	1.2.3	Domain and Range	Finding Domain and Range from Graphs
	1.2	1.2.4	Domain and Range	Finding Domains and Ranges of the Toolkit Functions
	1.2	1.2.5	Domain and Range	Graphing Piecewise-Defined Functions
	1.3	1.3.1	Rates of Change and Behavior of Graphs	Finding the Average Rate of Change of a Function
	1.3	1.3.2	Rates of Change and Behavior of Graphs	Using a Graph to Determine Where a Function is Increasing, Decreasing, or Constant
	1.3	1.3.3	Rates of Change and Behavior of Graphs	Analyze the Toolkit Functions for Increasing or Decreasing Intervals
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	1.7	1.7.3	Inverse Functions	Finding and Evaluating Inverse Functions
	1.7	1.7.4	Inverse Functions	Finding Inverse Functions and Their Graphs

SCOOL - Student-Centered Open Online Learning

Hello Test Student!

MATH 6 (03) - Precalculus
4dcc18e235b9b40a79d81691e155694fe6784683

Browse Available Practice Questions

Browse Available Assessments

Instructor View

SCOOL - Student-Centered Open Online Learning

Hello Test Student!

Browse Practice Questions

Please select a Chapter, a Section, and a Learning Outcome.

Chapter	Section	Learning Outcome
Select a Chapter	Select a Section	Select a Learning Outcome

Go

1.1.1. Determining Whether a Relation Represents a Function

Chapter Information

Learning Outcome Information

Timer: 00 : 10

Previous Question

Next Question

Question (1/5): 1.1.1

Determine whether the relation represents a function: $\{(a, b), (b, c), (c, c)\}$.

Allowed attempts: 1

- ○ Not a function
- ○ Function

Submit Answer

Attempts	Correct	Correct Answer
N/A	N/A	N/A

1.1.1. Determining Whether a Relation Represents a Function

Chapter Information ^

Chapter 1 Introduction

Toward the end of the twentieth century, the values of stocks of internet and technology companies rose dramatically. As a result, the Standard and Poors stock market average rose as well. Figure 1 tracks the value of that initial investment of just under $100 over the 40 years. It shows that an investment that was worth less than $500 until about 1995 skyrocketed up to about $1,100 by the beginning of 2000. That five-year period became known as the dot-com bubble because so many internet startups were formed. As bubbles tend to do, though, the dot-com bubble eventually burst. Many companies grew too fast and then suddenly went out of business. The result caused the sharp decline represented on the graph beginning at the end of 2000. Notice, as we consider this example, that there is a definite relationship between the year and stock market average. For any year we choose, we can determine the corresponding value of the stock market average. In this chapter, we will explore these kinds of relationships and their properties.

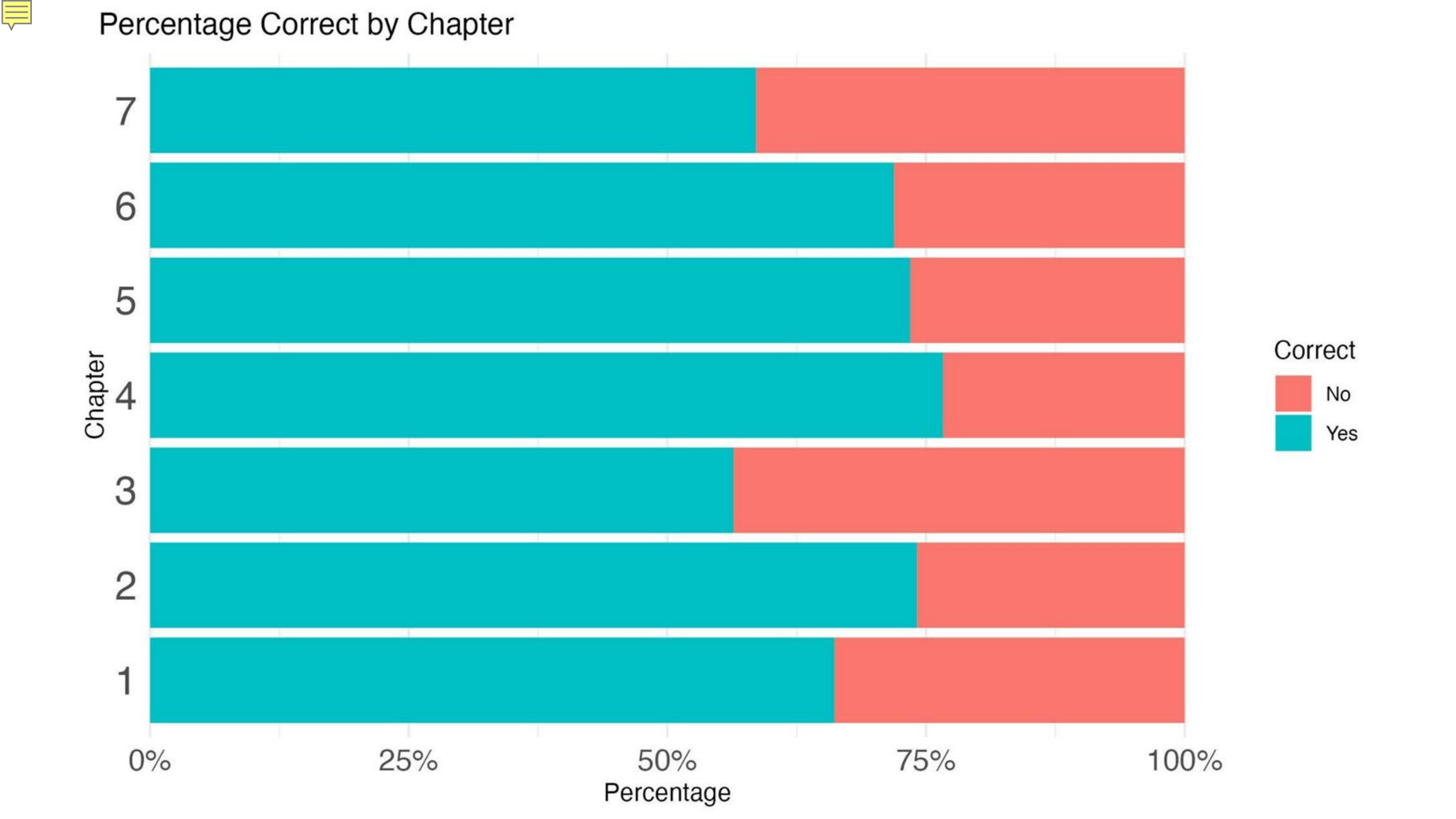
Introduction Review

Learning Outcome Information ^

Learning Outcome Tag: 1.1.1
Number of questions for this learning outcome: 5

By mastering this learning outcome, we suggest you to visit:
1.1.2- **Learning Outcome**: Finding Input and Output Values of a Function of **Section**: Functions and Function of **Chapter**: Functions
1.1.3- **Learning Outcome**: Determining Whether a Function is One-to-One of **Section**: Functions and Function of **Chapter**: Functions
1.1.5- **Learning Outcome**: Using the Horizontal Line Test of **Section**: Functions and Function of **Chapter**: Functions
1.1.6- **Learning Outcome**: Identifying Basic Toolkit Functions of **Section**: Functions and Function of **Chapter**: Functions

Learning Outcome Openstax document Video Document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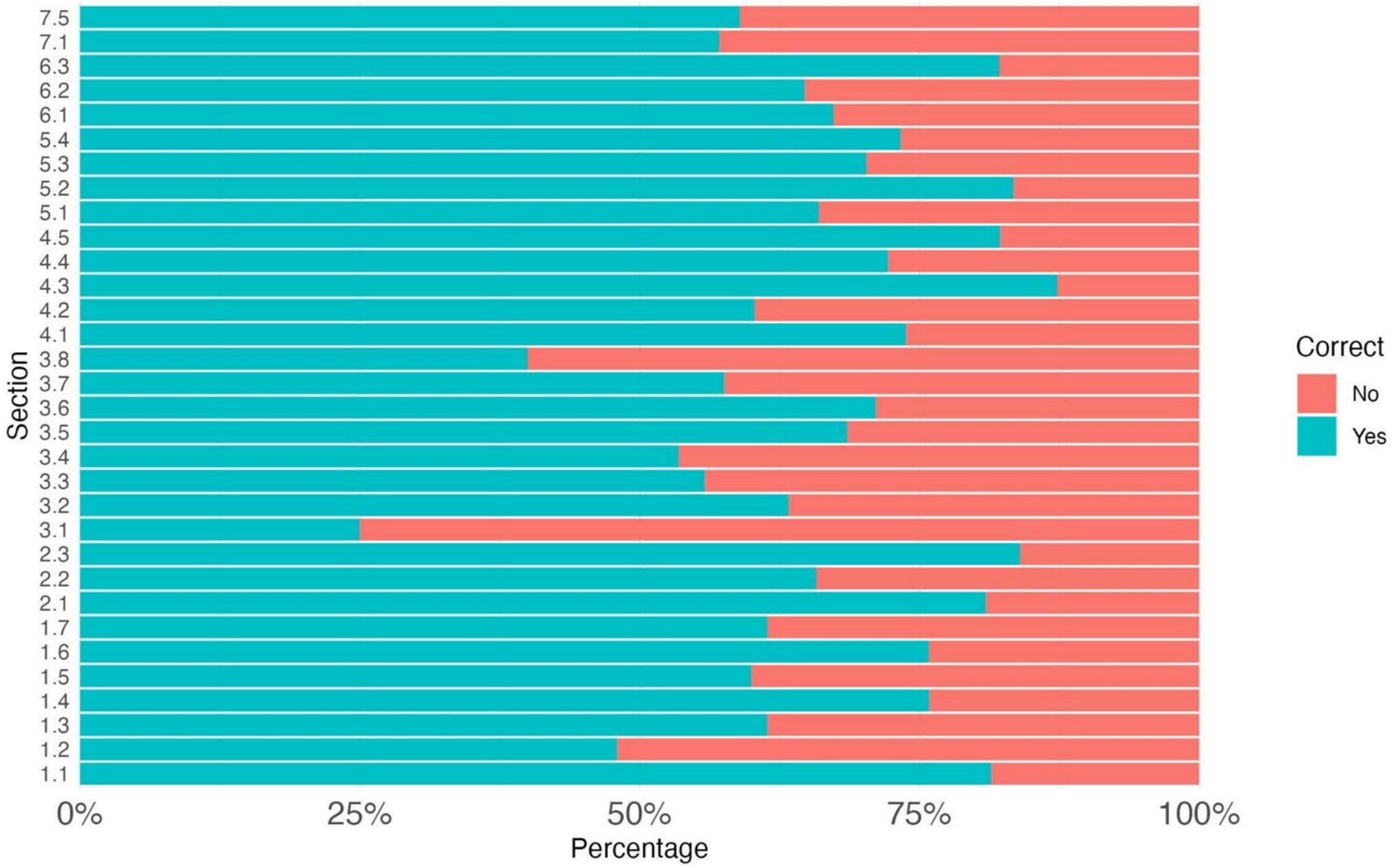
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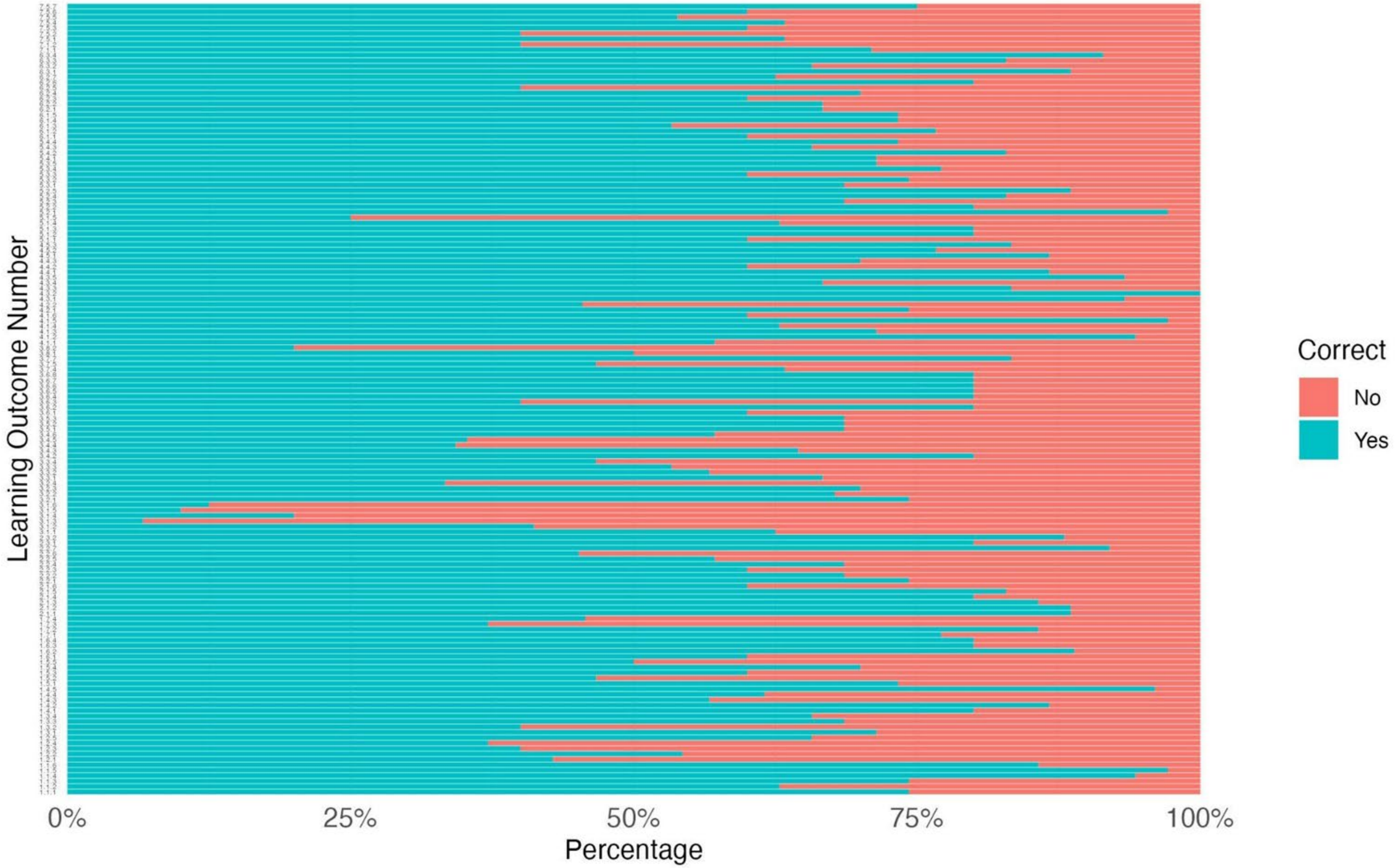
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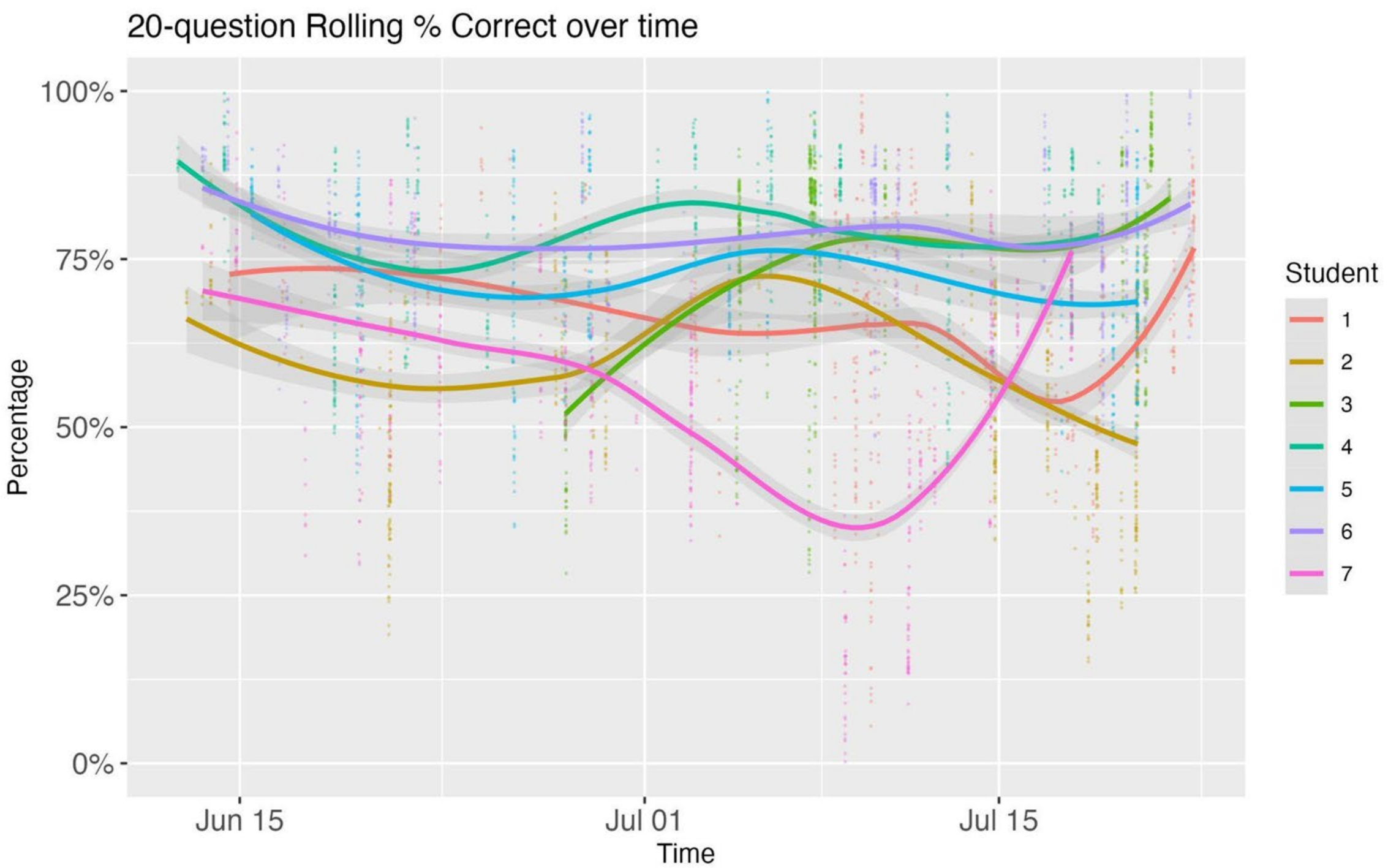
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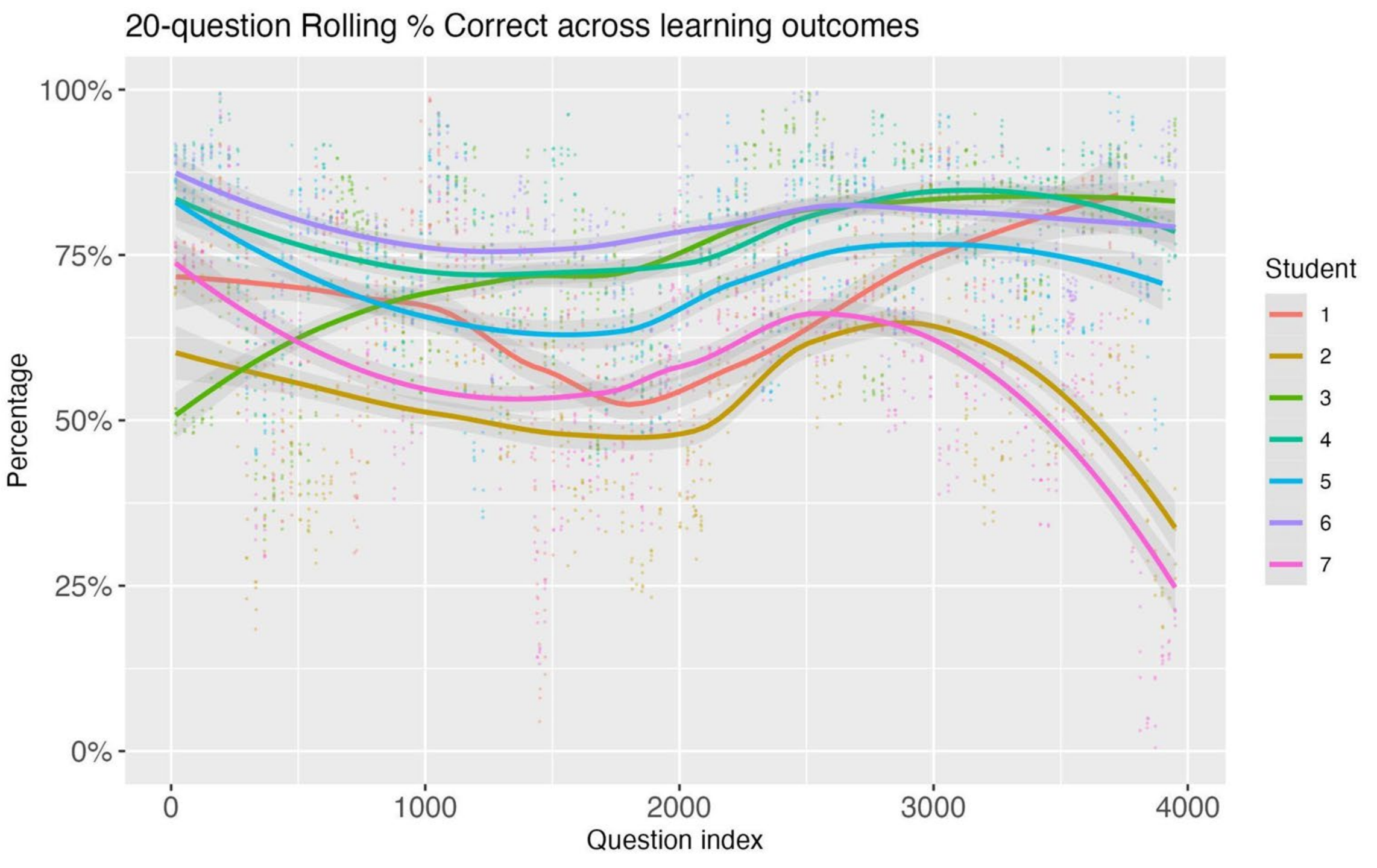
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Lessons Learned

- No simple set of ingredients that makes a “Culturally Responsive” classroom.
  - Ambiguity of what CRT “looks like”
  - Instructors were unsure if they were actually doing CRT – wanted a list of boxes to check off.
  - CRT is more like an “environment”

- Very difficult and time-consuming to create new software.
  - Obtaining buy-in from instructors very challenging.

Early instructor feedback

“Even if something seems really obvious from our perspective, a student could easily be lost”

“When there’s a lot of clicking to get to things, it’s very annoying.”

“By making it optional, . . . they just chose not to do those things.”

Next Steps

- Source code in github, available as an **OER.**
- Data analyses: compare **pre-post surveys** and **student performance data**.
- **Continued implementation** of SCOOL beyond grant period.

Recent instructor feedback

- *"I've had compliments from the students saying that this is **how a math class should be**."*
- *"I was very heavy in lecturing earlier. Now, then, I was **lecturing very less**."*
- *"It's been a fun process to develop activities that have the students work together in groups and not just on like canned examples from a textbook… using an actual building in Fresno, or something rather than just like a canned textbook problem. So it's that sort of thing to just make all of the applications **meaningful for students from the valley**."*

Thank you for your attention!

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- Department of Computer Science
  - Hubert Cecotti, hcecotti@mail.fresnostate.edu

Website:

- On-Ramp to STEM project website: https://bit.ly/onramptostem

Questions ???

On-ramp to STEM

The key to success in STEM is empowering all students to take ownership of their learning.

project website: bit.ly/onramptostem

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Giving the Ownership of Active Learning to Students in Computer Science (GOALD in CS)

Youwen Ouyang, Computer Science
Marisol Clark-Ibáñez, Sociology
California State University San Marcos

Project Overview

CSUSM

GOALS in CS

Partnership between CSU and CC

Focus on introductory sequence

Interactive online course content via Open Learning Initiative (OLI) and Canvas

Flipped classroom format

GOALS in CS by the numbers

- 37 sections
- 35 instructors
- 1548 students

Continued implementation after grant has ended.

Cultural Validation Theory

Culturally relevant: Accept and affirm the culture and identities of students of color. ACCEPTING

Culturally responsive: Use familiar cultural information and processes to scaffold learning. Emphasis on community and relationships (pedagogy). CONNECTING

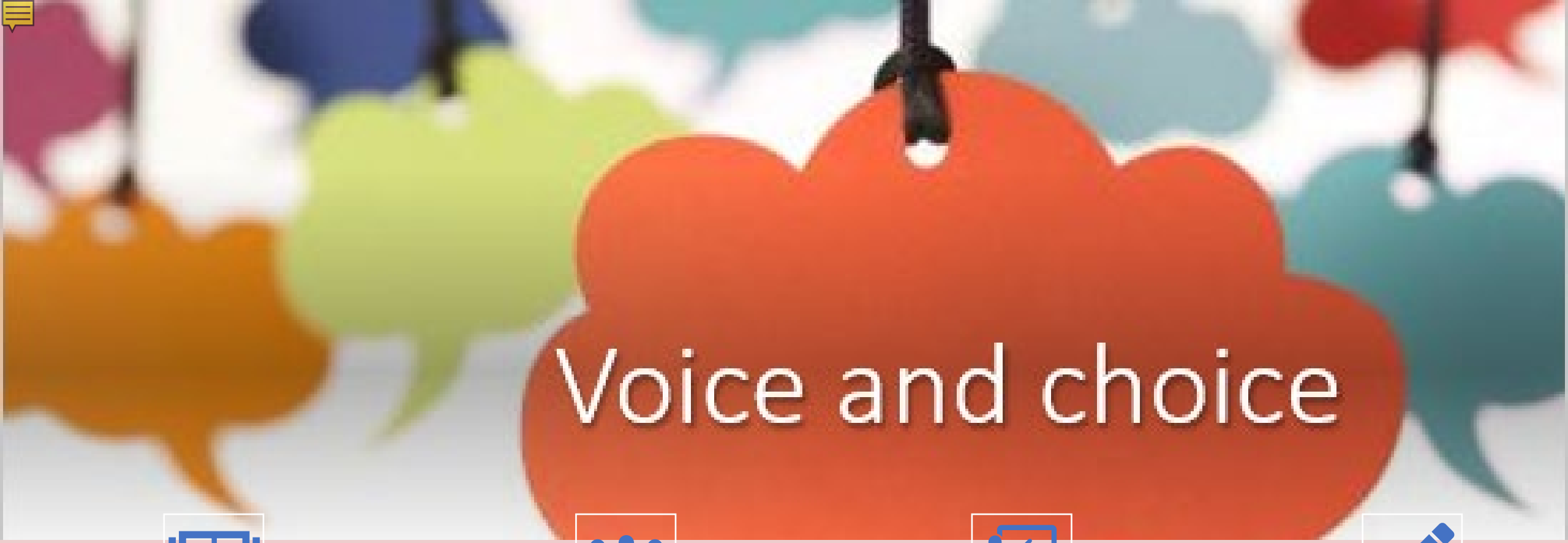
Culturally sustaining: Schools are places where the cultural ways of being in communities of color are sustained and not erased or seen as deficit. TRANSFORMING

Students Feel Validated When They Believe:

"I matter."

"Someone cares about me."

"I am a capable person."



Interactive textbook via Open Learning Initiative (OLI)

In-lecture group projects

In-lab individual projects with breakout room support

Individual programming homework

CSUSM

GOALS in CS

Methodology

Surveys

- **Data collection sites:** Introductory CS redesigned & non-redesigned courses at 2 HSIs
- **Collection period:** end-of-semester surveys from Fall 2019 - Fall 2022
- **Survey measures:** *career interests, student efficacy, active participation, student validation,* and *cultural relevance* in computer science.
- **N= 396** college students

Data analysis

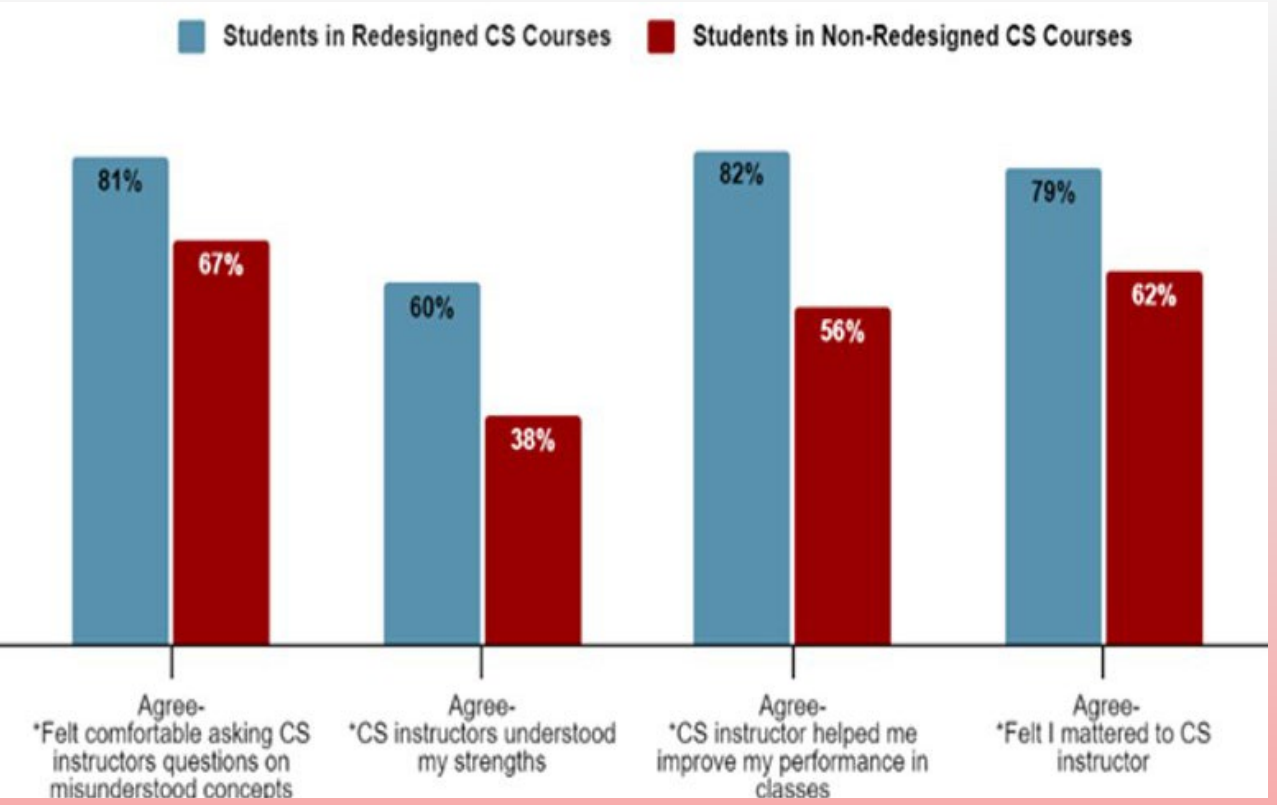
- **IBM SPSS** program (*version 26*)
- **Pearson's *chi-square-*** categorical survey responses & identify significant patterns between GOALS & Non-GOALS students in CS.

Results

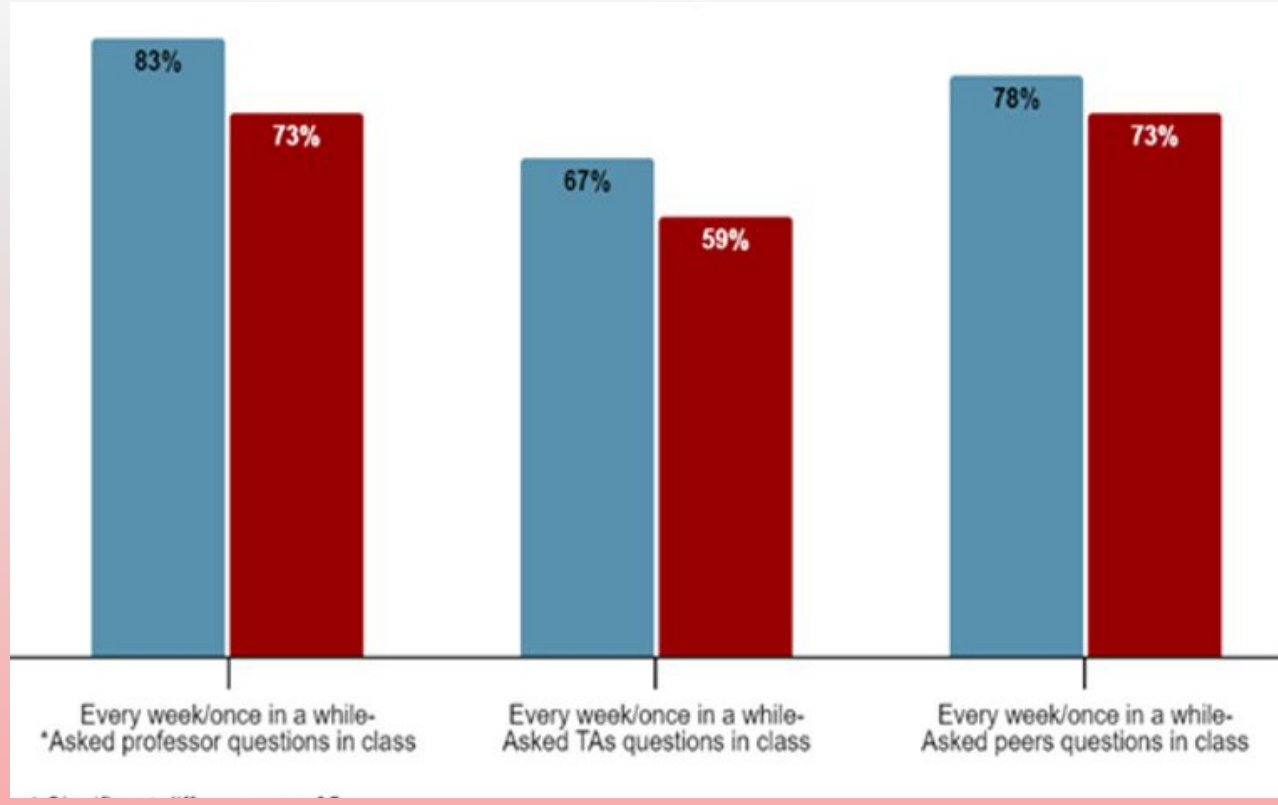
CSUSM

GOALS in CS

Student Validation



Active Participation



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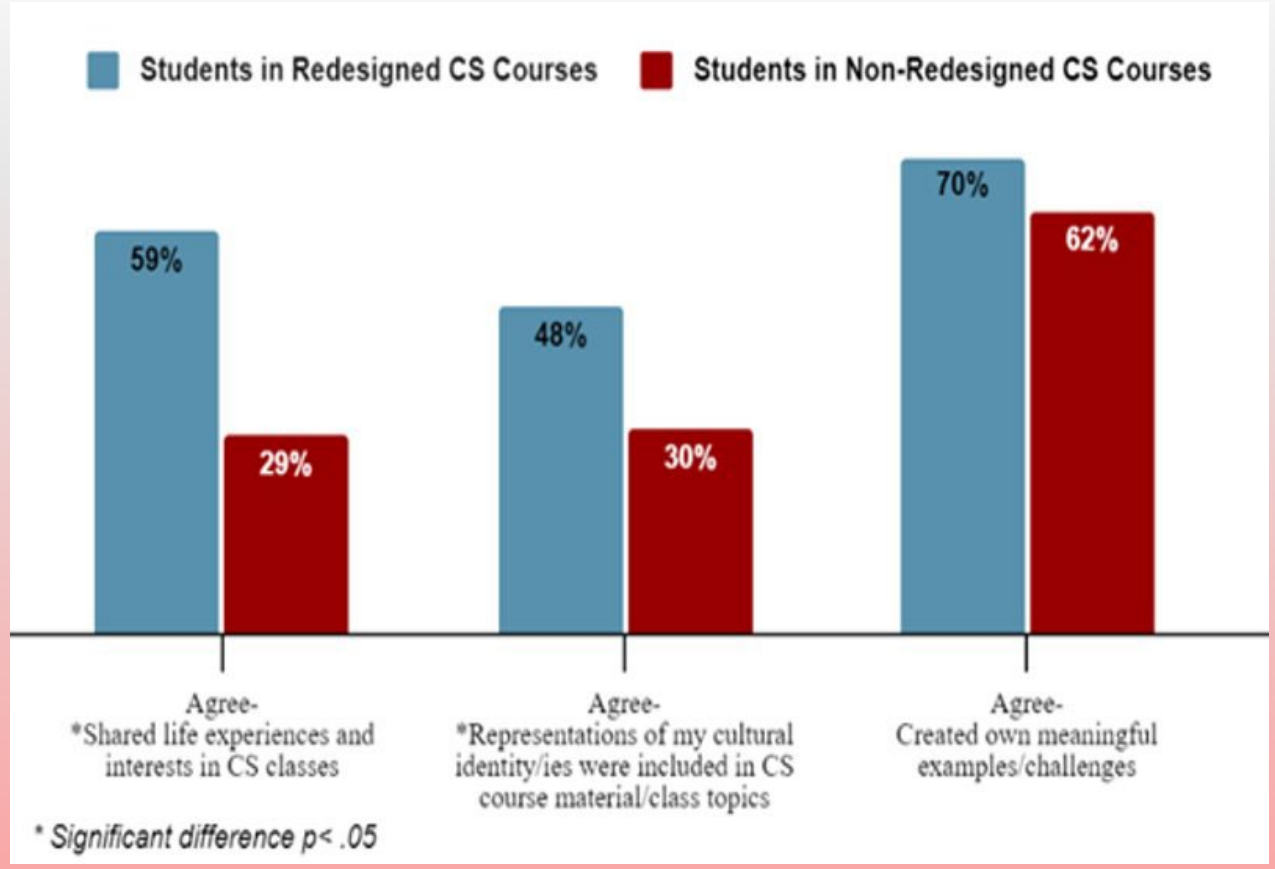
GOALS in CS

Results

Cultural Relevance

"I feel that I **was able to share my culture/interests through projects** when we were allowed to include this things in projects."

"This **course certainly provided exceptional cultural sensitive subject matter** while simultaneously providing comprehensive course content."



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GOALS in CS

Lessons Learned

- One size does not fit all
- Active, adaptive learning demands more responsive feedback
- Learning analytics provoke reflection and refinement
- Essential elements also must include:
  - Intentional conversations
  - Center student voices
  - Interdisciplinary collaborations

- Self-reflection can lead to culturally responsive teachers (*CS faculty)*
- Continued professional development needed (e.g., difficult to change)
- Classroom development: try things out, research & improve
- Share strengths: building like-minded faculty and/or department (e.g., hiring priorities)

Summary

CSUSM

GOALS in CS

The highly iterative and collaborative redesign featured:

- **Skill Mapping:** students & CS faculty contributed to the development
- **Flipped Classroom:** interactive, online material
- **Classroom Community:** active learning with students as near-peer mentors in class
- **Culturally Sustaining:** content and pedagogies
- **Continuous Data Collection:** focus on student voice on progress, successes, and challenges
- **Training:** Support and coaching provided for CS faculty

Thank you!

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A Sampling of CSU California Education Learning Lab (CELL) Awardees

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Next Steps/Closing Remarks

Dr. Frank A. Gomez
Executive Director, STEM-NET
Office of the Chancellor

https://www2.calstate.edu/impact-of-the-csu/research/stem-net

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A Sampling of CSU California Education Learning Lab (CELL) Awardees

Webcast Feedback Survey

Please take a few moments to tell us about your webcast experience.

Use the QR Scan Code to download it

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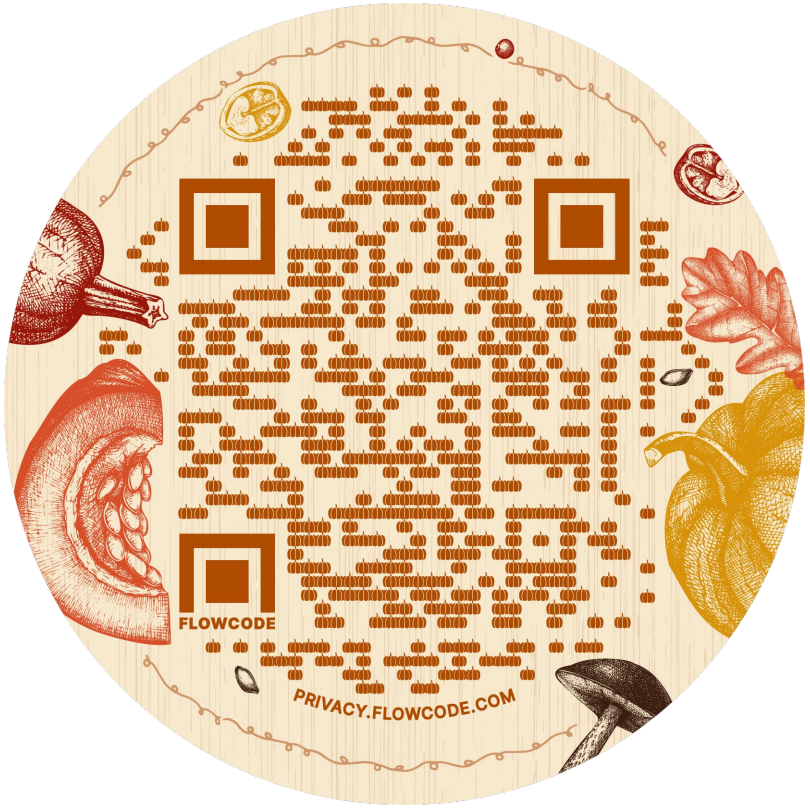
STEM-NET Community Events

STEM-NET February Webcast

Topic: Department of Education Awardees
Date: Feb. 7, 2024
Time: 10:00 AM- 12:00 PM

Register Here



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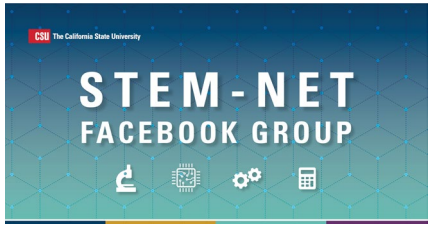
STEM-NET Community Groups

Join our CSU STEM-NET Community listserv

csustemnet@lists.calstate.edu



Begin a Conversation with Colleagues and Join our Private CSU STEM-NET Facebook Group

https://www.facebook.com/groups/2629611737269292

A Sampling of CSU California Education Learning Lab (CELL) Awardees

For more information about STEM-NET visit our website:

THANK YOU FOR JOINING US TODAY!

Frank A. Gomez *CSU Office of the Chancellor* *fgomez@calstate.edu*