

Measuring the Pedagogical Impact on Undergraduate Students Through Frequent, Low-Stakes Pre- and Post-Lecture Self-Assessments

Biomedical Engineering Education Community
(BEEC)

UC San Diego

JACOBS SCHOOL OF ENGINEERING

Shu Chien-Gene Lay Department of Bioengineering



Reem Khojah, Ph.D.

Assistant Teaching Professor
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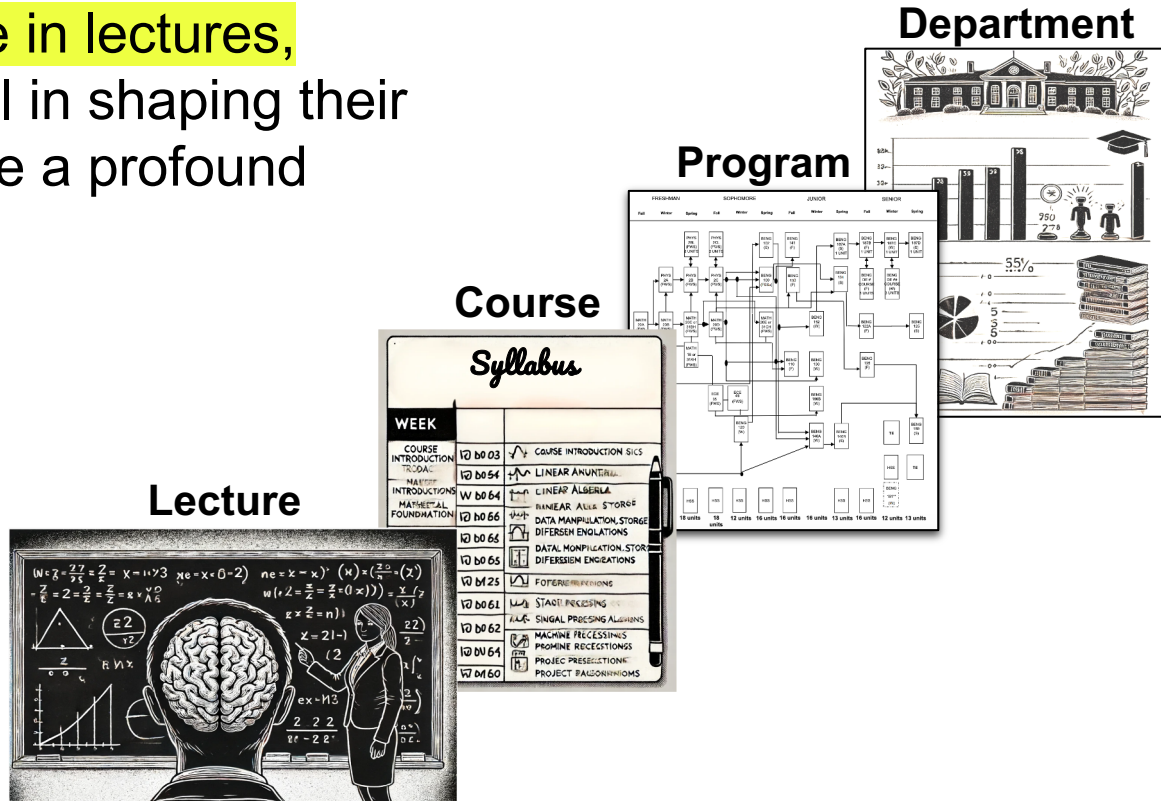


**Josephine Relaford-Doyle,
Ph.D.**

Education Specialist, Engaged
Teaching Hub
Teaching + Learning Commons
UCSD

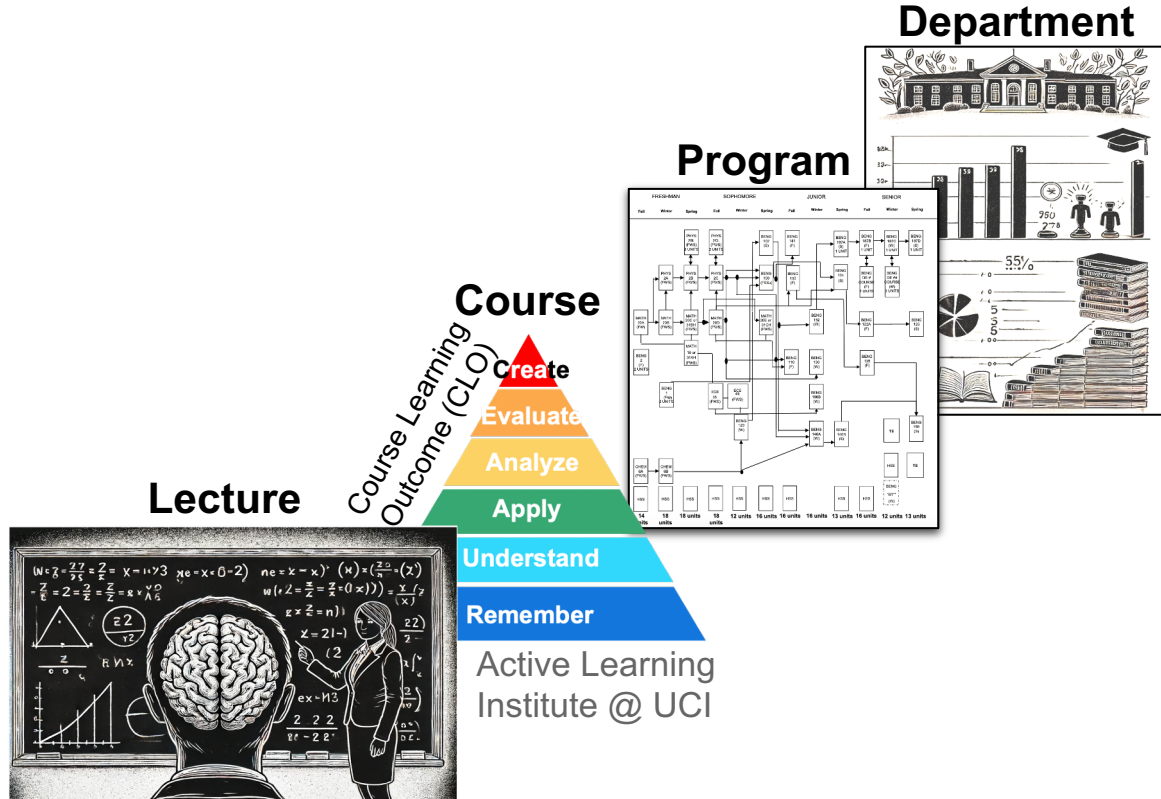
Introduction

Students spending approximately **25% of their academic life in lectures**, these sessions are pivotal in shaping their academic output and have a profound impact on multiple levels.



Motivation

Personal story when I when I first began teaching at UCSD



ACTIVE LEARNING INSTITUTE



WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

**Center for the Integration
of Research, Teaching
and Learning**

**The
CIRTL
Network**

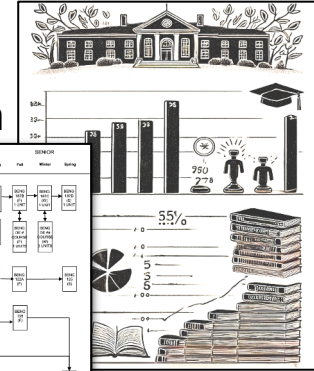
Center for the
Integration of Research,
Teaching and Learning

<https://dtei.uci.edu/workshops-professional-development/>

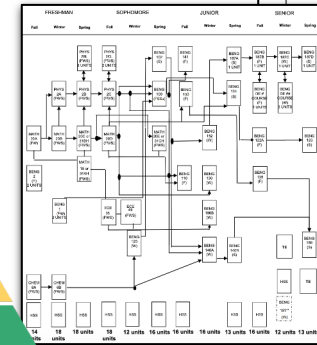
<https://cirtl.net/>

Personal story when I when I first began teaching at UCSD

Department



Program



Course



Understand

Remember

Active Learning
Institute @ UCI

Lecture



Motivation

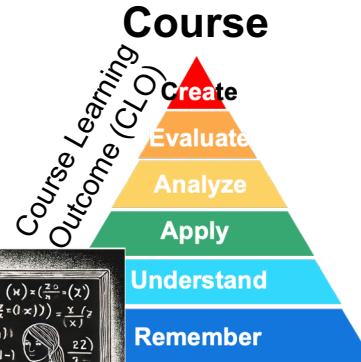
Unable to obtain

- accurate
- measurable

student feedback to gauge their understanding during lectures.



Lecture

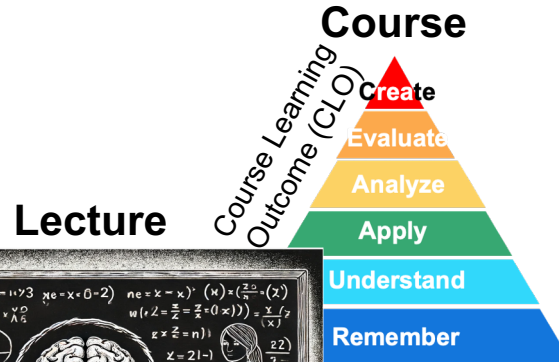


Motivation

Unable to obtain

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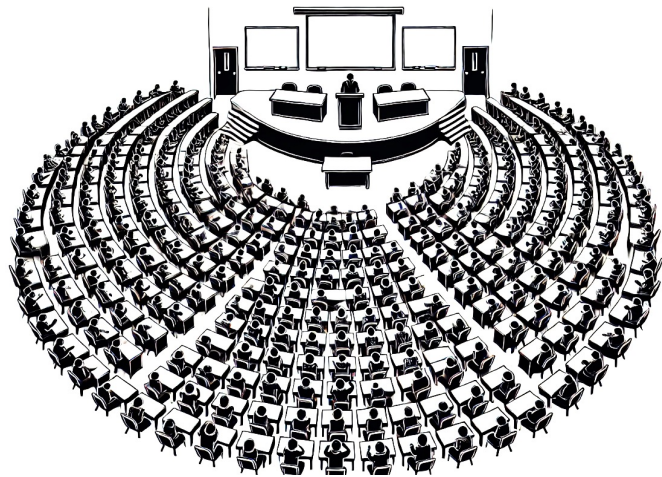


Motivation

Unable to obtain

- accurate
- measurable
- scalable

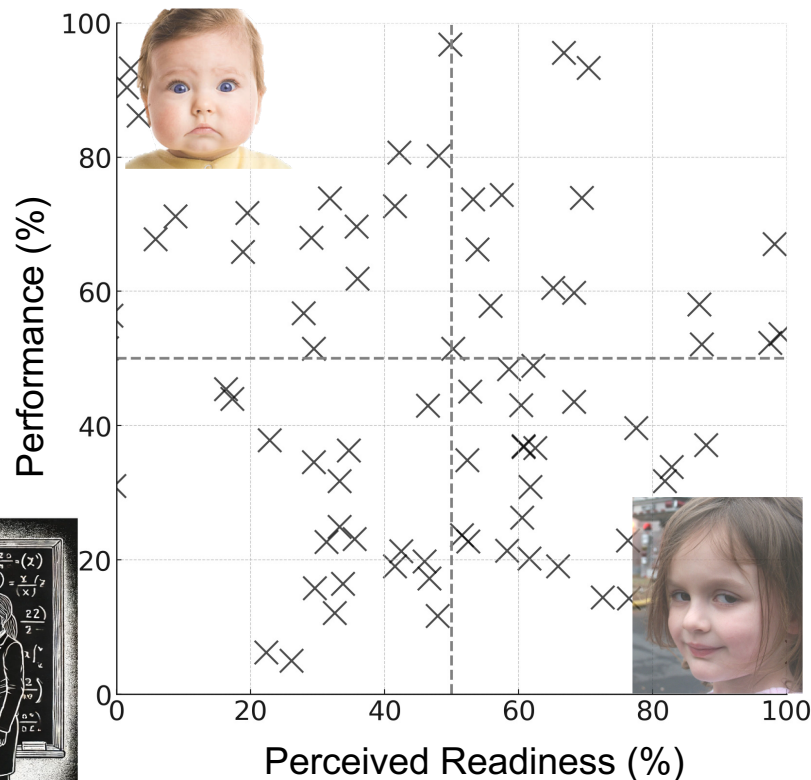
student feedback to gauge their understanding during lectures.



Lecture



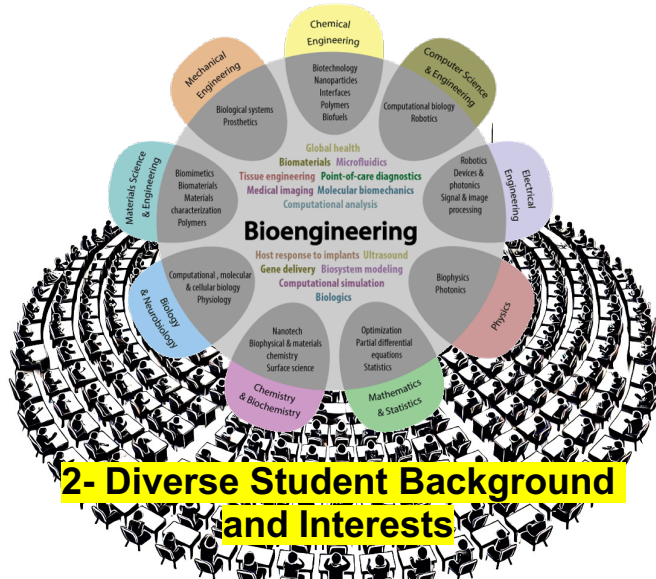
Gauging Understanding of Students
in the Lecture



Motivation

Why this is particularly important in Bioengineering?

1- Interdisciplinary Cumulative Learning Process



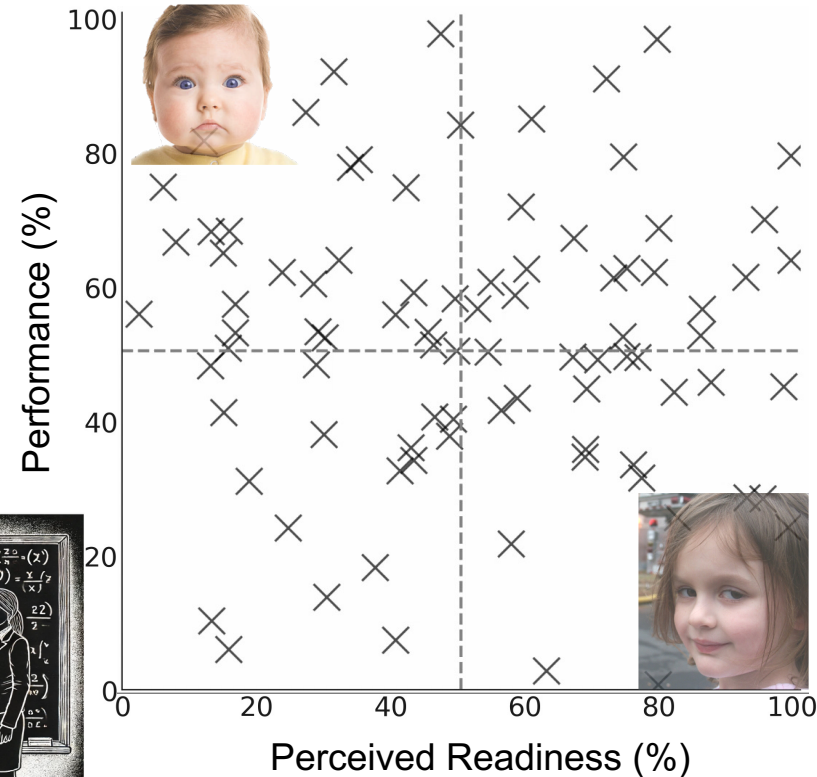
2- Diverse Student Background and Interests

<https://bioe.uw.edu/academic-programs/about-bioengineering/>

Lecture



Gauging Understanding of Students Every Lecture

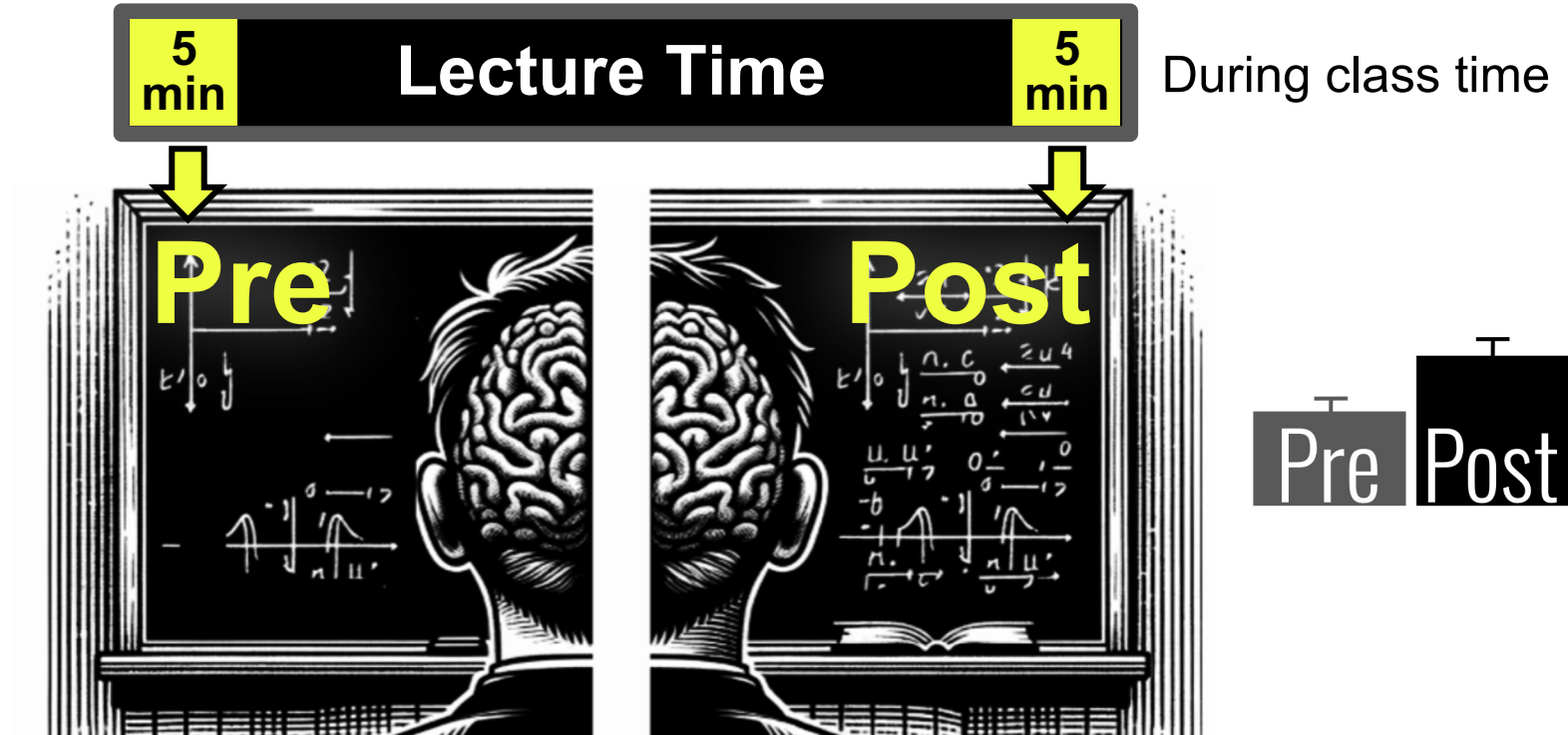


Pre/post Lecture Formative Assessment

Test the students on the lecture learning outcomes

Test before lecture

Test after lecture



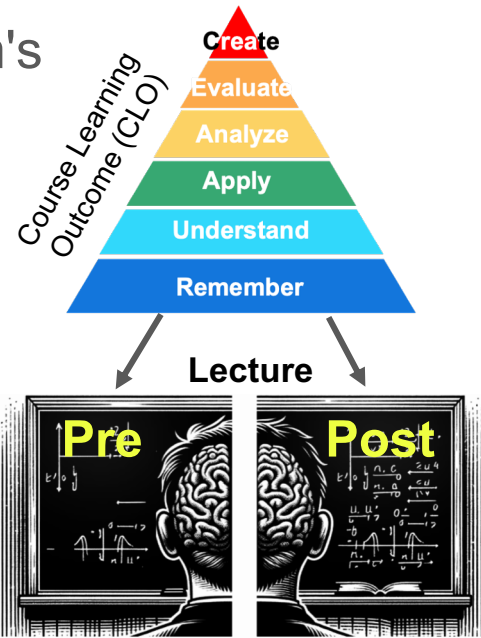
Pre/post Lecture Formative Assessment

To measure how much students grasp the concepts from the lecture learning outcomes, we used Bloom's Taxonomy to structure the assessment questions

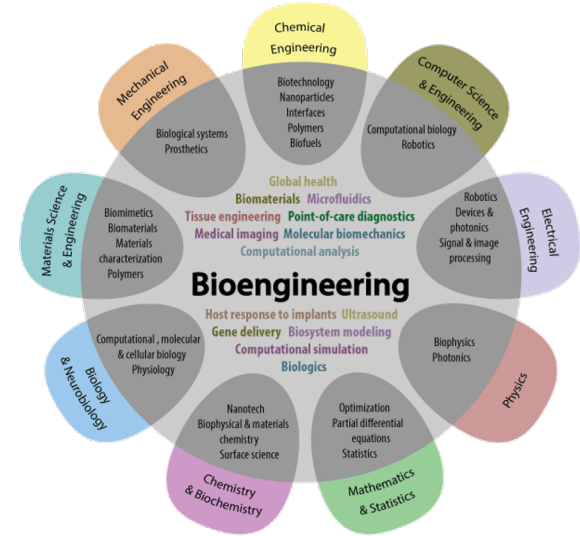


Josephine Relaford-Doyle, Ph.D.

Education Specialist,
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Hub Teaching +
Learning Commons
UCSD



Interdisciplinary Cumulative Learning



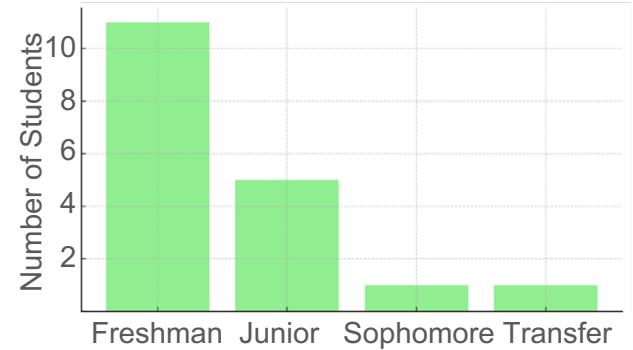
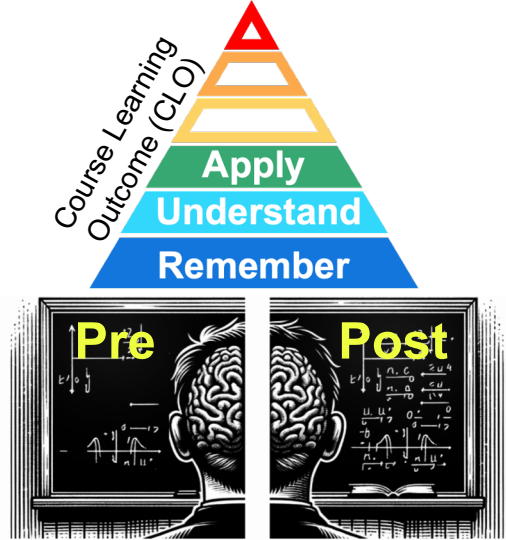
<https://bioe.uw.edu/academic-programs/about-bioengineering/>

Brink, Issues in Accounting Education, 2013.
Meibom et al., 1994.
Linsey et al., Advances in Engineering Education, 2009.
Nevid & Mahon, Teaching of Psychology, 2009.
Sweeney et al., Current Problems in Diagnostic Radiology, 2022.

Pilot Study on Bioengineering Undergraduate Students

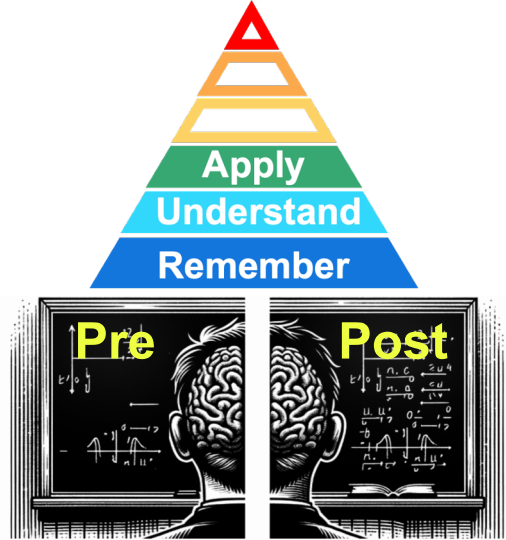
Conducted a pilot study with freshmen, focusing on Bloom's Taxonomy using pre- and post-class tests in a programming class.

First three levels of Bloom's Taxonomy:
Remember,
Understand,
and application.



Design Pre/post Lecture Formative Assessment

1. High participation -> low-stakes + anonymous



Design Pre/post Lecture Formative Assessment

1. High participation -> low-stakes + anonymous
2. Frequent (each lecture) -> MCQ + short time

Pre-Knowledge Level: What data type can store...

Scalar

Matrix

Array

String



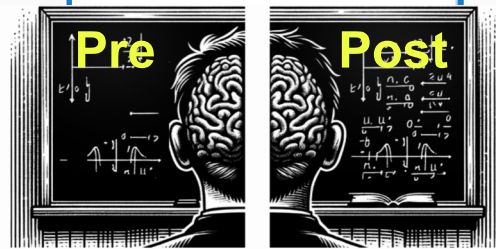
Post-Knowledge Level: What data type can stor...

Scalar

Matrix

Array

String



Design Pre/post Lecture Formative Assessment

1. High participation -> low-stakes + anonymous
2. Frequent (each lecture) -> MCQ + short time
3. Meaningful measurement -> MCQ option “I don’t know + ”

Pre-Knowledge Level: What data type can store...

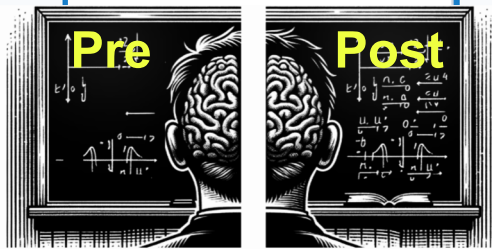
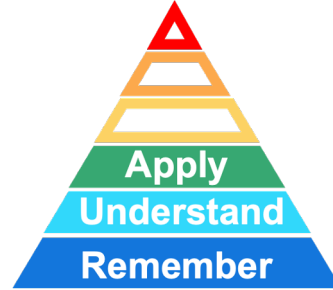
Scalar

Matrix

Array

String

😞 I don't know yet, but will learn it in the lecture 😊



Post-Knowledge Level: What data type can stor...

Scalar

Matrix

Array

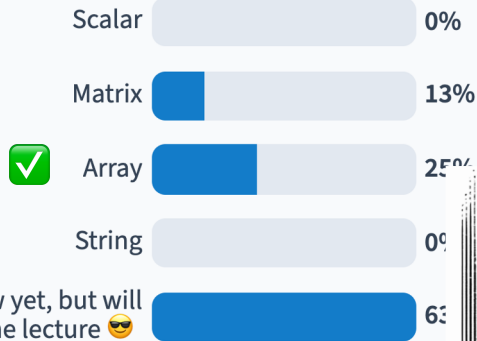
String

😞 I don't know, but will find out after class 😊

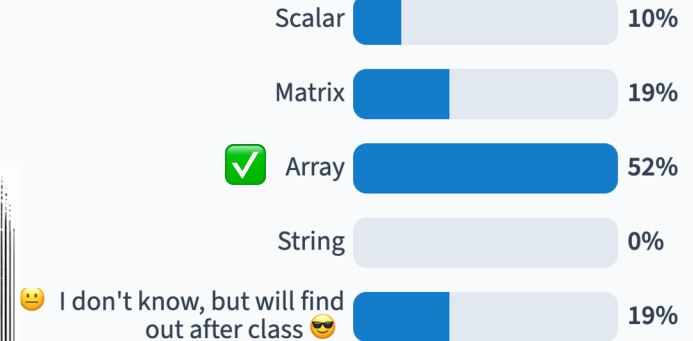
Design Pre/post Lecture Formative Assessment

1. High participation -> low-stakes + anonymous
2. Frequent (each lecture) -> MCQ + short time
3. Meaningful measurement -> MCQ option “I don’t know + ”
4. Accessible feedback -> discuss after class + share

Pre-Knowledge Level: What data type can stor...



Post-Knowledge Level: What data type can stor...



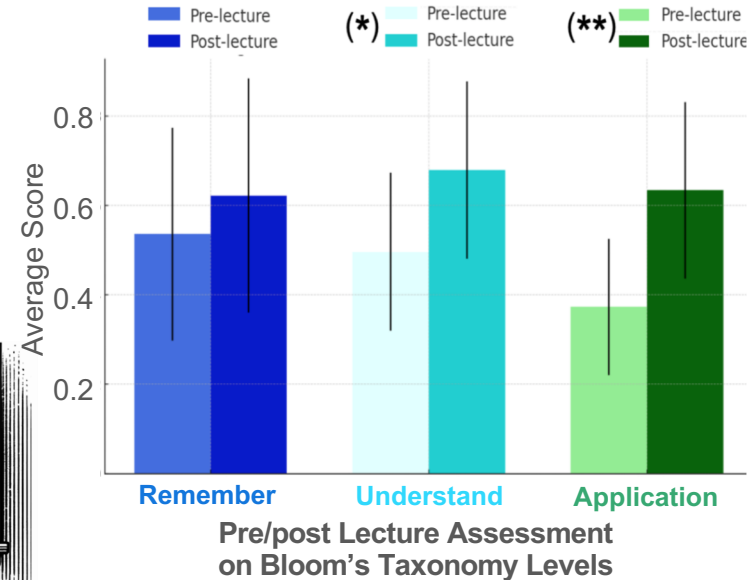
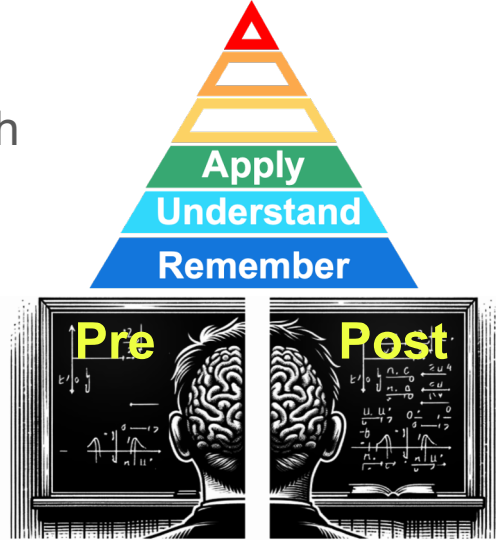
Results of Pre/Post Lecture Assessment on Student Learning

Method: Paired t-tests were used to compare each student's pre- and post-lecture scores in all lectures

Pre-Lecture Results: Students scored lower on the pre-lecture test, with scores decreasing as the Bloom's taxonomy level increased.

Post-Lecture Results:

Post-lecture scores showed significant improvement, with 60% of the class answering correctly in all 3 levels.

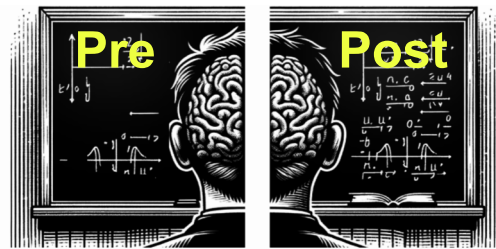


Pre/Post Assessment May Provide Insight on Student Overall Performance

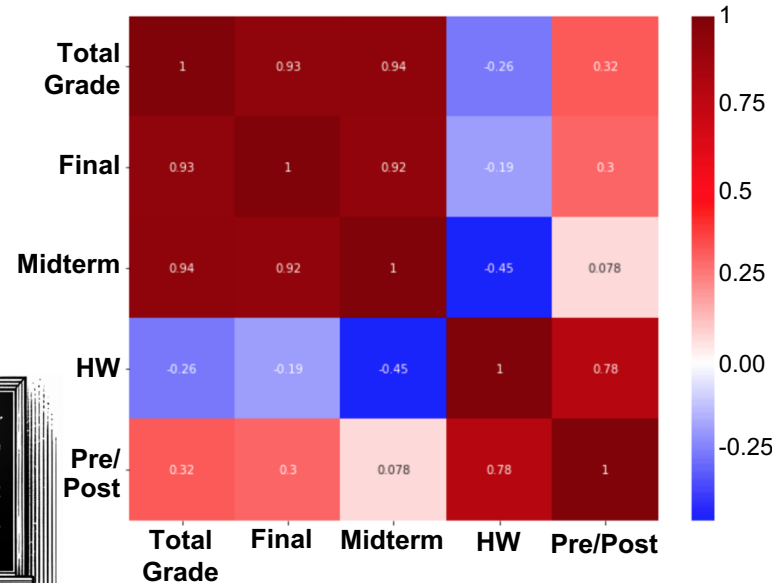
Method: Analyzed the average outcomes of all Pre/Post self-assessments, midterms, and final exams.

The Pre/Post self-assessment grade showed a notably higher correlation for low-performing students compared to homework grades.

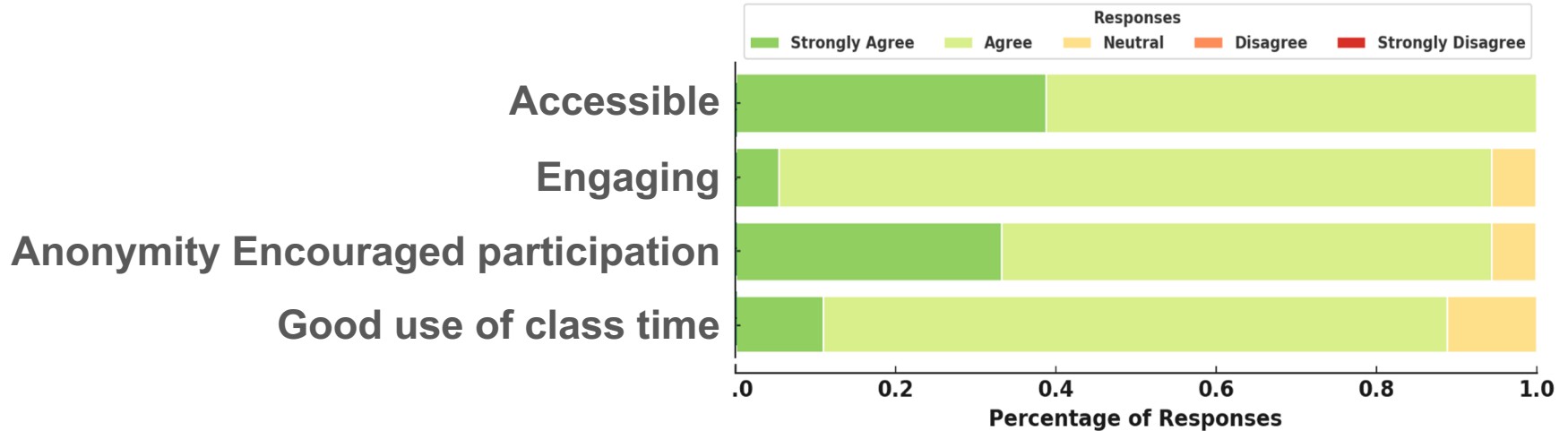
Pre/Post assessment can mediate early intervention for challenged students



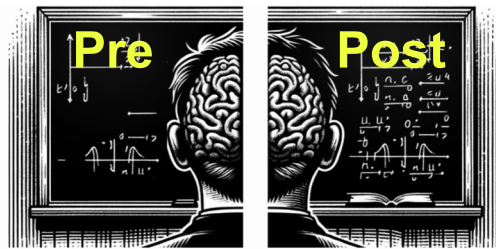
Pearson Correlation Matrix Heatmap



Strong Student Buy-in

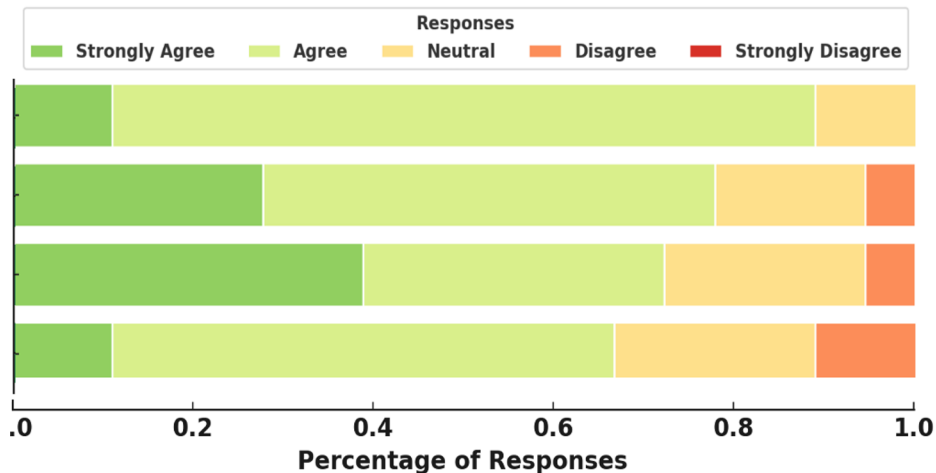


Lecture

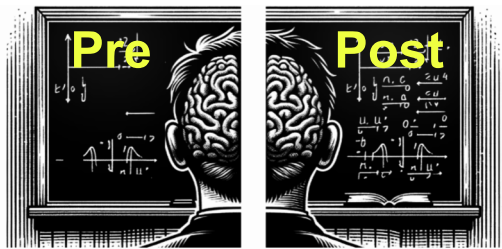


Pre/Post Improved Teaching and Learning Experience

Highlighted core concepts
Helped me assess my understanding
Instructor used Pre/Post to improve class
Pre/post improved my understanding



Lecture



Instructor's Perspective

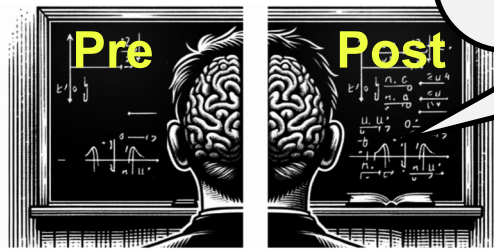
During class: Effective Classroom Management

Pre-test: Real-time Feedback

Post-test: Proactive Early Intervention

End-course: Positive Evaluation

Lecture



"The pre/post lecture quizzes helped me know how was I doing with the subject, if I needed to put more effort or if I had to keep in line with the topic that was introduced that day."

Students' comments from the course evaluations

Instructor's Perspective

But.. Extra hours before and after class!

- Additional time to de-identifying students and obtaining **IRB** approval (IRB-807339).
- Additional time to **prepare questions**, grading, and conducting statistical analysis.
- Additional time needed to **share** results anonymously with students via Poll Everywhere, as students frequently requested after class.

PrePostClass.com

Demo

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Reem Khojah, Ph.D.

Assistant Teaching Professor
Bioengineering Department
UCSD

Pre/post Lecture Self-Assessment

1. Scan
QR code



prepostclass.com/demo

2. Take
Pre-Test

Start Pre-Lecture Test

Enter your email [Start Quiz](#)

Pre-Lecture Test

Q1: Which specific type of bacteria is primarily responsible for the sour taste in sourdough bread?

- ☐ Bacillus cereus
- ☐ Lactobacillus sanfranciscensis
- ☐ Escherichia coli
- ☐ Staphylococcus aureus

Q2: What is the main byproduct of fermentation by wild yeast in sourdough?

- ☐ Ethanol

3. Listen to
lecture

(Keep page open)

Thank You!

Please don't close the page.

Now, listen closely to the instructor.

wait until the end of the lecture to take the post-lecture test.

[Start post-lecture test](#)

4. Take
Post-Test

Post-Lecture Test

Q1: Which specific type of bacteria is primarily responsible for the sour taste in sourdough bread?

- ☐ Bacillus cereus
- ☐ Lactobacillus sanfranciscensis
- ☐ Escherichia coli
- ☐ Staphylococcus aureus

Q2: What is the main byproduct

Check Your Answers

Results:

Q1: Which specific type of bacteria is primarily responsible for the sour taste in sourdough bread?

The Science Behind Making Sourdough Bread



The Science of Sourdough Bread

Sourdough
Starter



The Science of Sourdough Bread

Sourdough
Starter

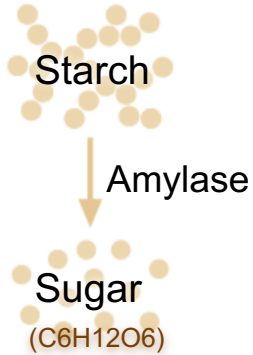
**Wild
Yeast**

water
+
flour



The Science of Sourdough Bread

**Wild
Yeast**



Sourdough
Starter

water
+
flour

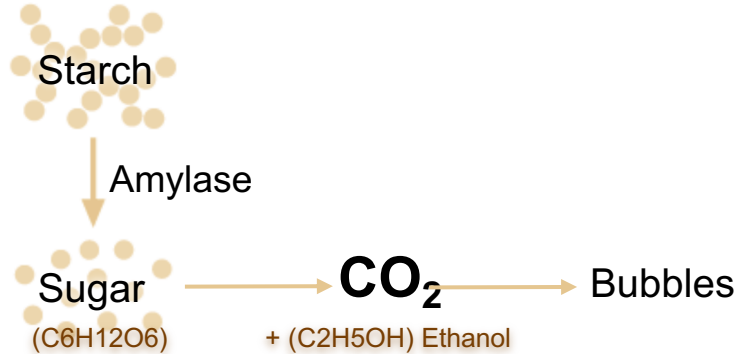


The Science of Sourdough Bread

Sourdough
Starter



**Wild
Yeast**

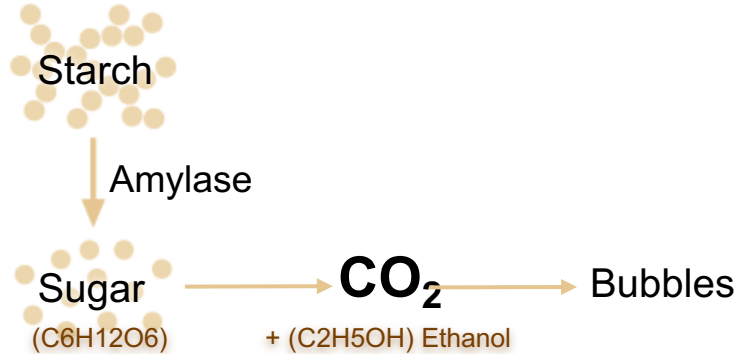


The Science of Sourdough Bread

Sourdough
Starter



**Wild
Yeast**



Bread rise



The Science of Sourdough Bread

Sourdough
Starter



**Wild
Yeast**



Amylase



+ (C_2H_5OH) Ethanol

Bubbles

Bread rise



**Lactic
Acid
Bacteria**



Sour flavor

The Science of Sourdough Bread

Sourdough
Starter



**Wild
Yeast**



Amylase



+ (C₂H₅OH) Ethanol

Bubbles

Bread rise



**Lactic
Acid
Bacteria**

Lactic acid
(C₃H₆O₃)



Low pH
Long Time



Sour flavor

Digestible

Pre/post Lecture Self-Assessment

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QR code



prepostclass.com/demo

2. Take
Pre-Test

Start Pre-Lecture Test

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Pre-Lecture Test

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3. Listen to
lecture

(Keep page open)

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Post-Lecture Test

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- ☐ Staphylococcus aureus

Q2: What is the main byproduct

Check Your Answers

Results:

Q1: Which specific type of bacteria is primarily responsible for the sour taste in sourdough bread?

Now let's check the results
and compare
your PRE and POST Answers

Pre-Post questions

Q1: Which specific type of bacteria is primarily responsible for the sour taste in sourdough bread?

- a) *Bacillus cereus*
- b) *Lactobacillus sanfranciscensis*
- c) *Escherichia coli*
- d) *Staphylococcus aureus*

The correct answer is: b) *Lactobacillus sanfranciscensis*

Pre-Post questions

Q2: What is the main byproduct of fermentation by wild yeast in sourdough?

- a) Ethanol
- b) Lactic acid
- c) Acetic acid
- d) Carbon dioxide

The correct answer is: d) Carbon dioxide

Pre-Post questions

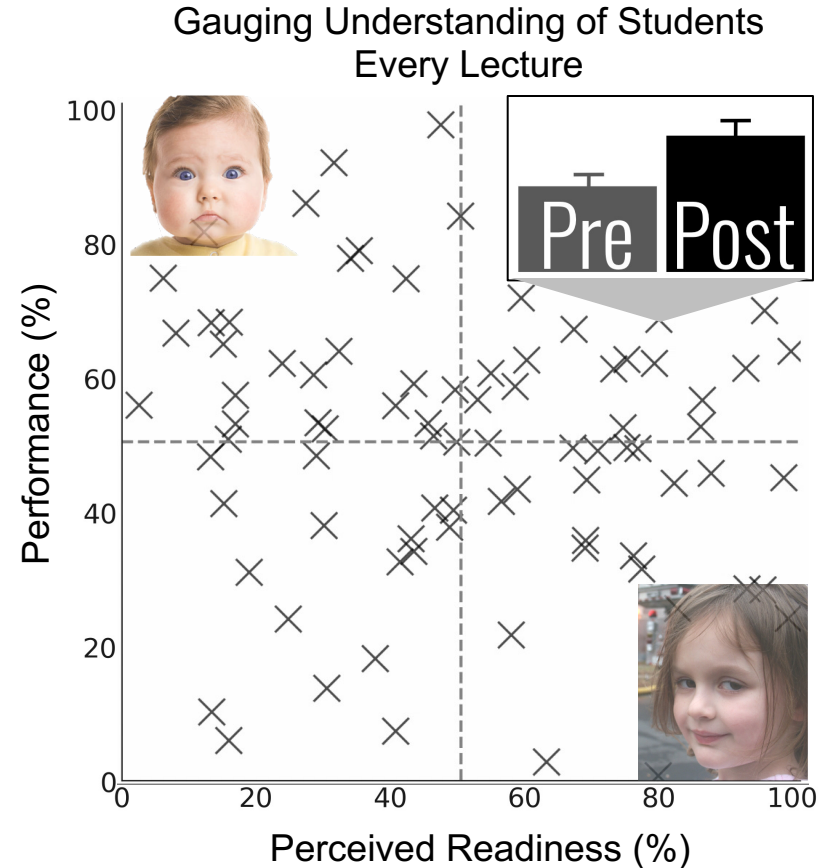
Q3: Which of the following methods can help speed up the sourdough bread-making process without affecting its digestibility?

- a) Decrease water, decrease the amount of starter in the dough, decrease pH, and decrease temperature.
- b) Decrease water, increase the amount of starter in the dough, decrease pH, and increase temperature.
- c) Increase water, increase the amount of starter in the dough, decrease pH, and decrease temperature.
- d) Increase water, decrease the amount of starter in the dough, increase pH, and increase temperature.

The correct answer is: b) Decrease water, increase the amount of starter in the dough, decrease pH, and increase temperature.

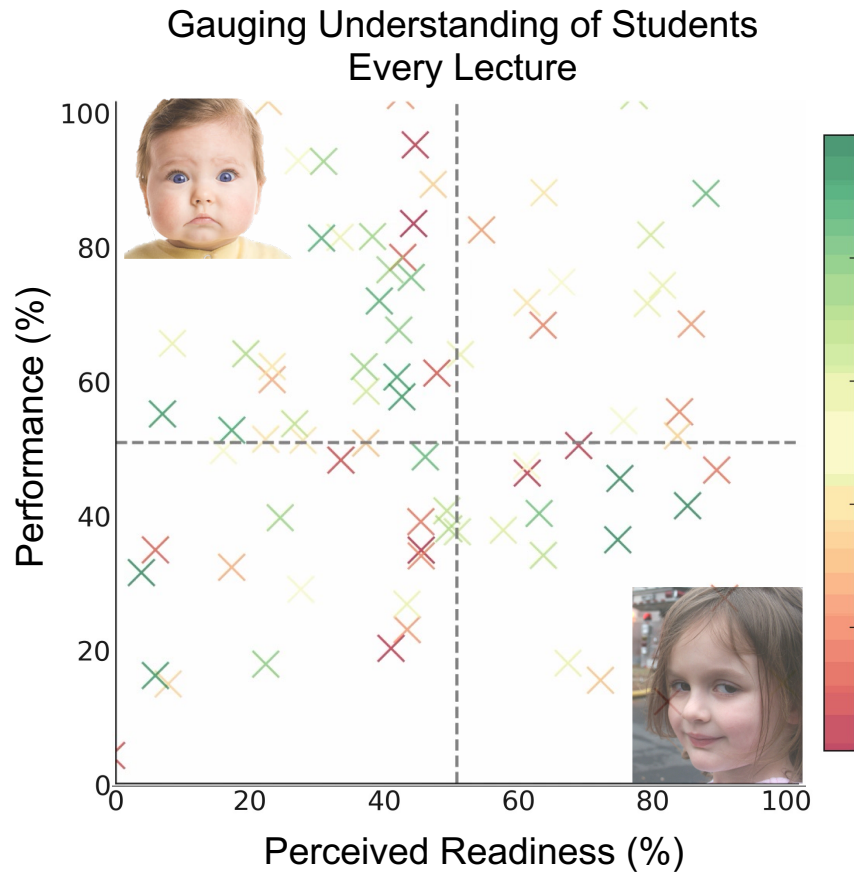
Comments from ASEE

- Generating questions takes time for each lecture
- Data analysis and student feedback



Comments from ASEE

- Generating questions takes time for each lecture
- Data analysis and student feedback

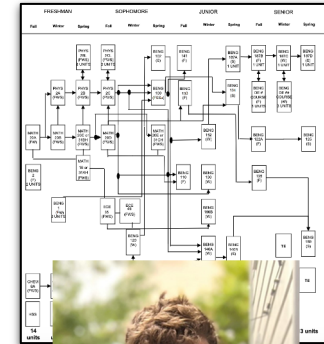




Center for Advancing Multidisciplinary Scholarship for Excellence in Education

<https://camsee.ucsd.edu/>

- Claire Meaders (Cell and Developmental Biology)
- Crystal Goldman (Libraries)
- Tricia Bertram Gallant (Academic Integrity Office and Triton Testing Center)
- Erilynn Heinrichsen (Teaching and Learning Commons)
- Erica Heinzman (Education Studies)
- Mia Minnes (Computer Science and Engineering)



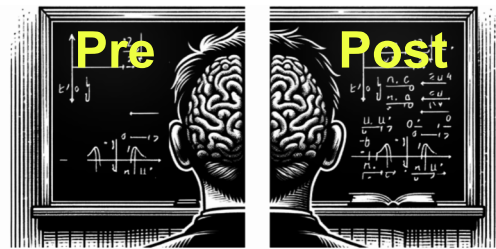
Liam Mueller
Biological
Science
Department

Pre/Post Assessment May Provide Insight on Student Overall Performance

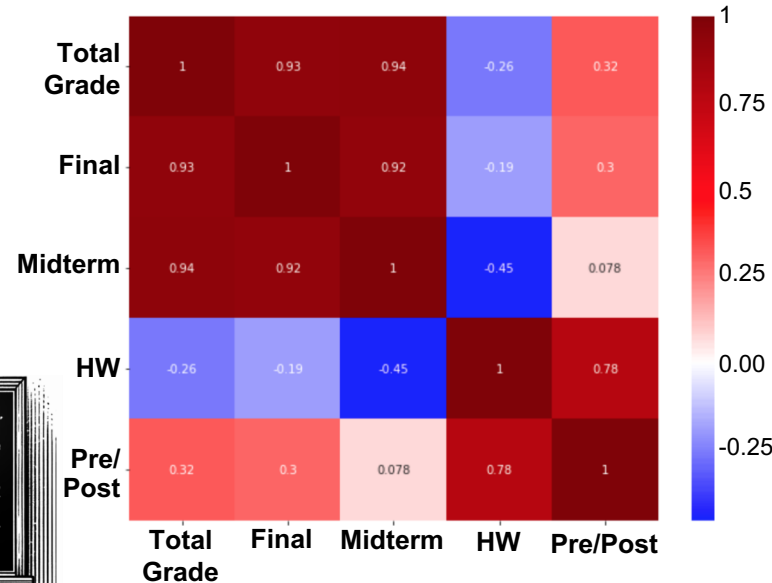
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Pre/Post assessment can mediate early intervention for challenged students



Pearson Correlation Matrix Heatmap



Moving assignments in class

https://www.reddit.com/r/Professors/comments/1bozeu6/inclass_quiz_d_2024/



publishandperish • 7mo ago •

I moved my assignments into the classroom because of AI. It's only a matter of time before I have to stop doing that because of accommodation requests.



46



Reply



Award



Share



Prof172 • 7mo ago •

This is the boat I'm in, too. I want to give quizzes based on homework and allow students to use their homework as notes on the quiz. It'd be perfect: those who did and understood the homework would do well on the quizzes and feel good about the effort they put into the homework. This would allow me to de-emphasize homework in the category weights. But I'm not sure how to pull it off with accommodations. If a student has a class before mine, they won't be able to start the quiz early in Student Success and then join class. Maybe I'll make it up as I go along.



10



Reply



Award



Share



liquidInkRocks • 7mo ago •

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Members

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 Online

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r/AskFeminists

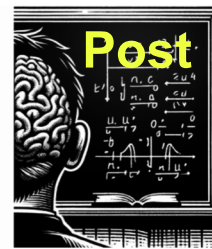
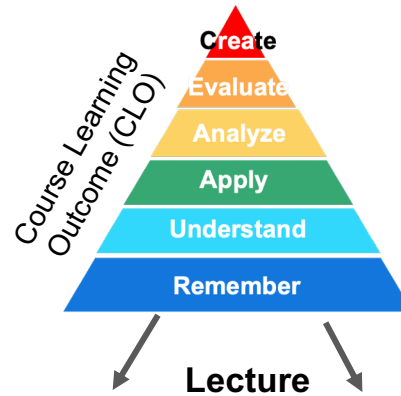
Inade and MBAs believe in a concept called

Conclusion

Pre/post Lecture Self Assessment

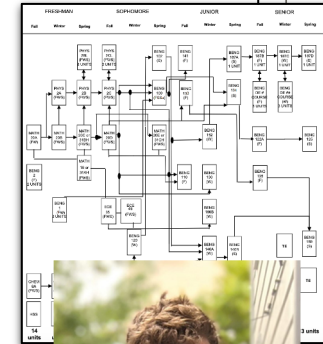
- Enhance student learning
- Provide early feedback to instructors.

Stay Tuned for Pre/Post
1-Study on Graduate BioE
course (all Bloom's levels)
2-BioSci Program level
implementation

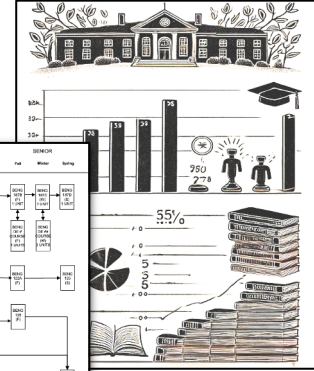


BIO
SCI

Program



Department



Liam Mueller
Biological
Science
Department

Thank you!

rkhojah@ucsd.com

Let's stay connect!



Reem Khojah, PhD
Assistant Teaching Professor
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