Teaching Corequisite Statistics

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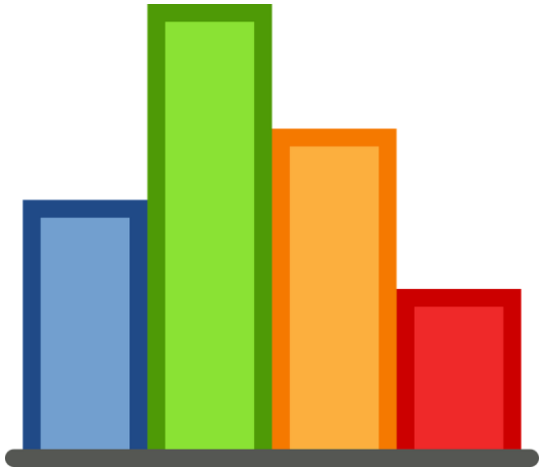
In Partnership with Complete College America



Hi there! I’m Rachel.

- Full-time math faculty and Outcomes & Assessment Co-coordinator at Cuyamaca College
- Former Math Coach for the California Acceleration Project
- Prior K-12 teaching experience
- Just finished a doctorate
- Mom of a two-year-old

Sneak Peek of Today's Presentation

- A brief history of the creation of Statistics with Corequisite Support at Cuyamaca College
- Curriculum design principles
- A typical day in the corequisite statistics classroom
- Supporting faculty with a community of practice

A brief history

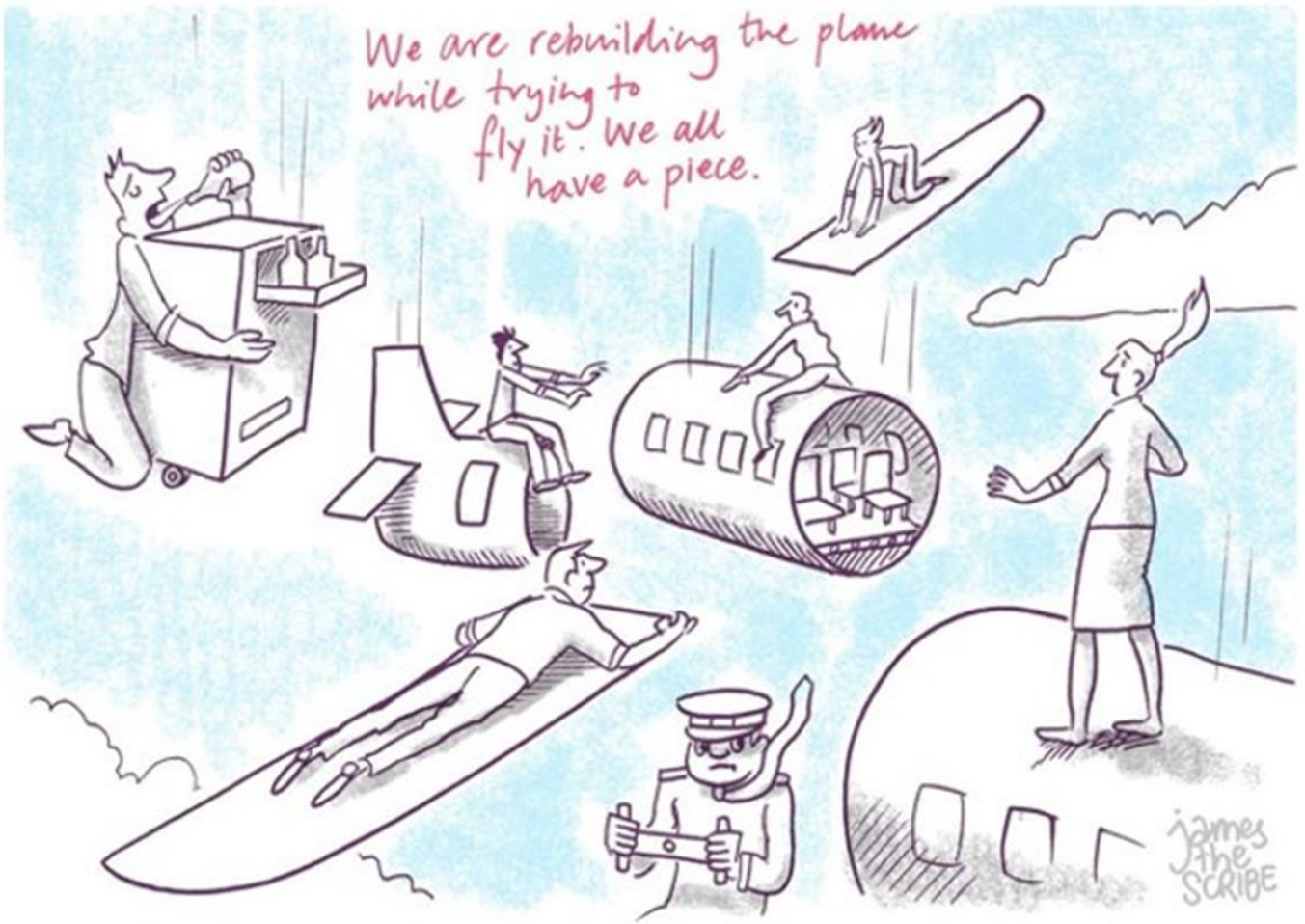
We looked at our data - students placing three levels below transfer had only a 6% change of ever making it to transfer-level.

Realization - something needed to change

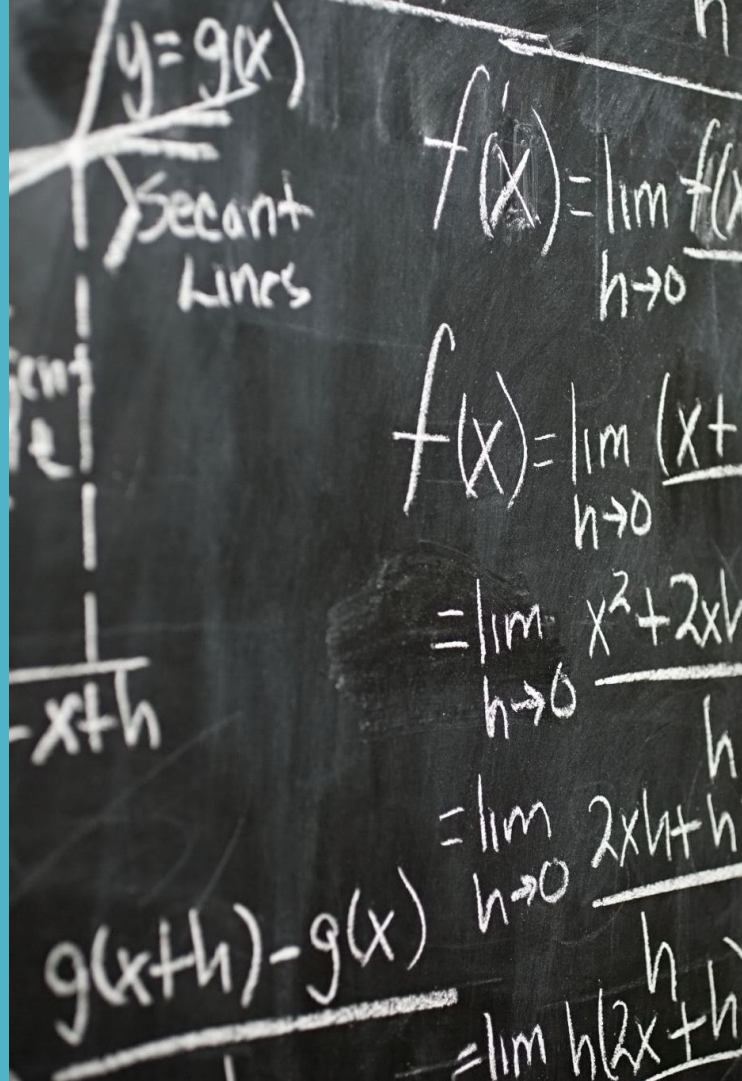
We took a leap of faith and decided to allow all students to access transfer-level math courses, offering corequisites to help those in need (this was later mandated by law).

Did the whole department agree? Were we sure it was going to work? We probably couldn't do much worse than we were already doing.

A team of faculty on reassign time developed materials, attended professional development, and trained faculty who were teaching the corequisite courses


We are rebuilding the plane while trying to fly it. We all have a piece.
James the SCRIBE

We not only changed placement and access to transfer-level math, but we also changed how we teach.



Changes to Curriculum

Goodbye drill and kill of decontextualized math skills.

Challended the belief that students cannot master higher-level concepts without first showing proficiency in basic skills

Hello just-in-time review.

Student success and persistence are highest when the remediation is relevant and contextualized.

(Rutschow & Schneider, 2011)

Changes to Teaching Pedagogy

Goodbye Lecture

- If lecture worked for developmental education students, they wouldn't need remediation – so clearly, lecture-based instruction does not meet their learning needs.

(Boylan & Saxon, 1999)

Hello Low-Stakes Collaborative Practice

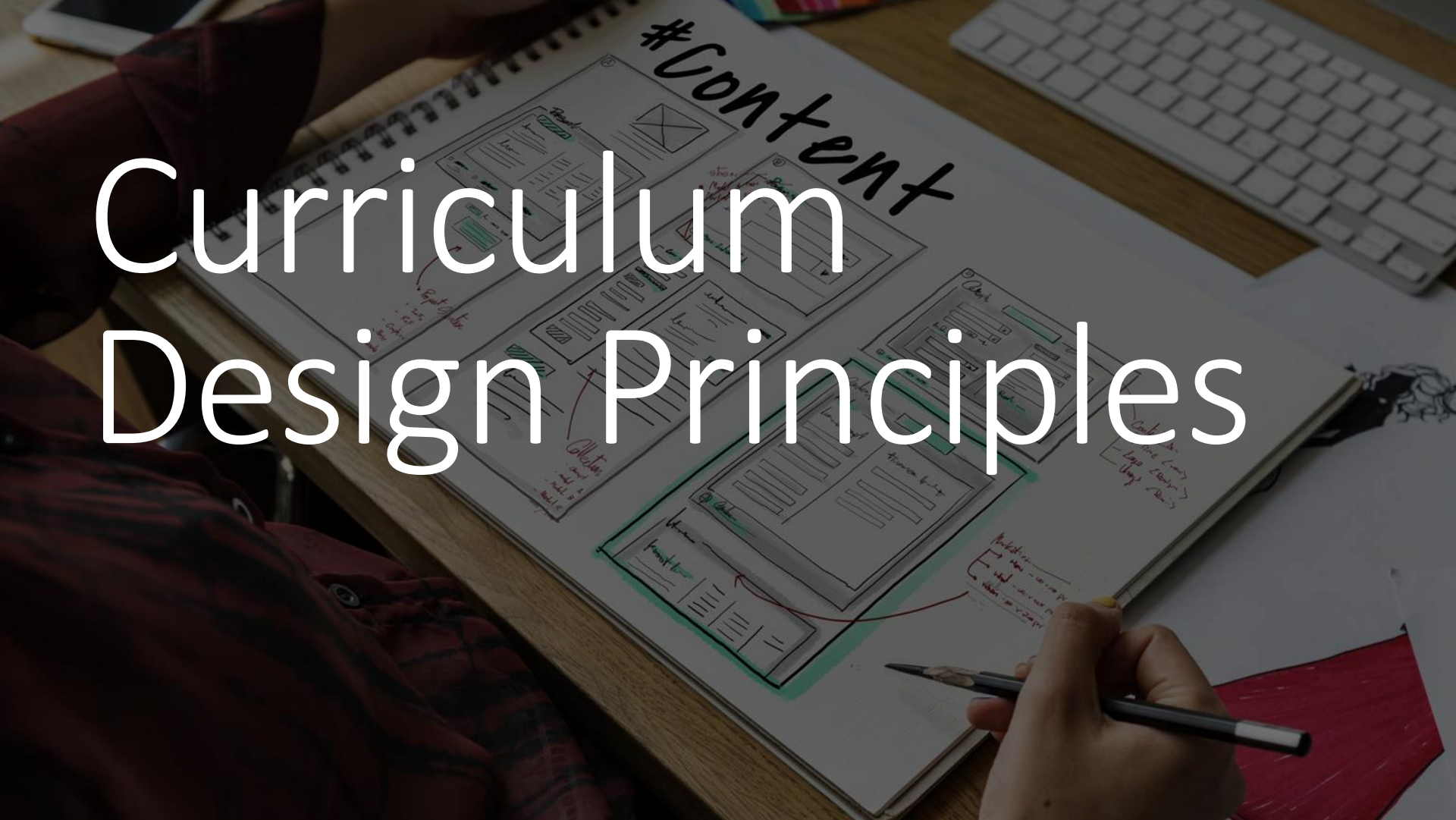
- Students need opportunities to practice college-level tasks in a low-stakes classroom environment
- The connection and community that comes from group learning is especially important for marginalized populations of students.

(Hern & Snell, 2013; Tinto, 1997)

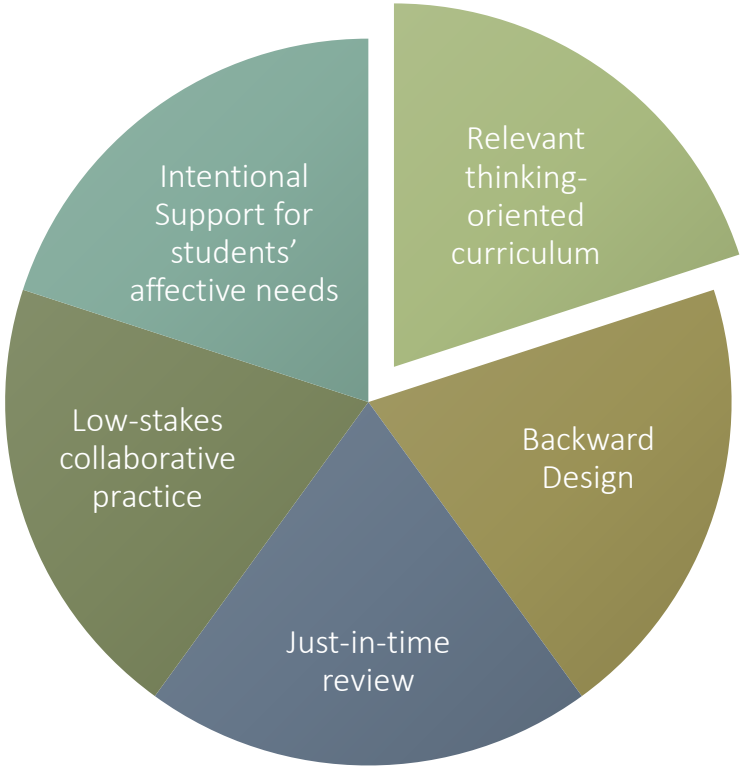
Attending to the Affective Needs of Students

Faculty need to reflect on classroom policies and procedures to see how they can "reduce students' fear, increase their willingness to engage with challenging tasks, and make them less likely to sabotage their own classroom success."

- Hern & Snell, 2013



Curriculum Design Principles



California Acceleration Project Design Principles

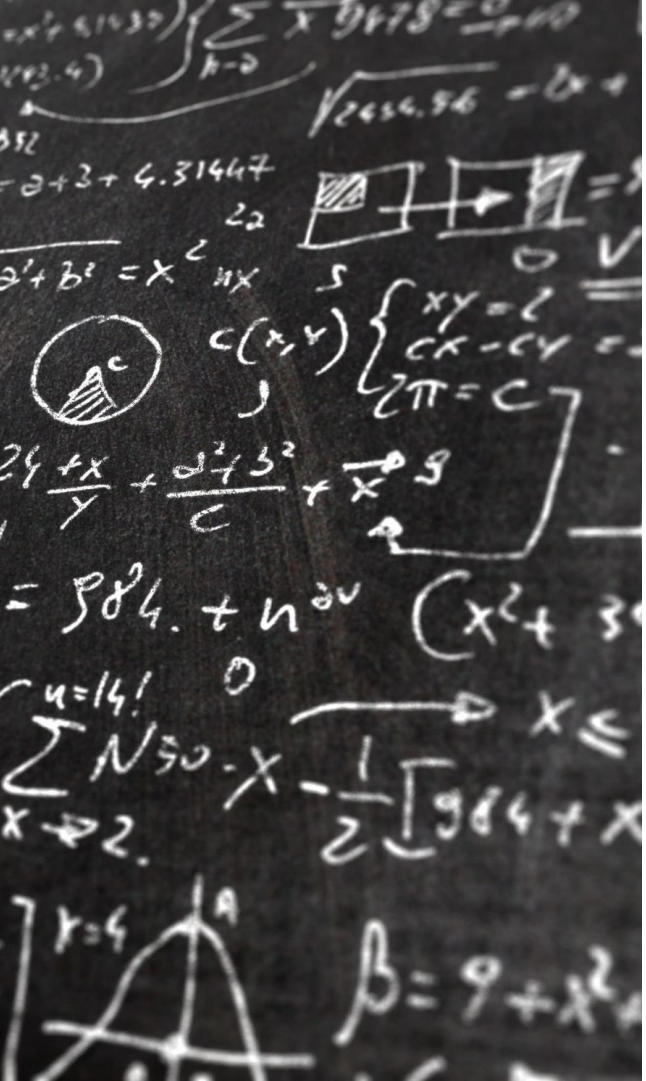
Read more about these design principles.

Relevant Thinking-Oriented Curriculum

This kind of curriculum asks students to engage with issues that matter, wrestle with open-ended problems, and use resources from the class to reach and defend their own conclusions.

Conceptual and contextual. Not rote or procedural.

High-challenge and high-support!



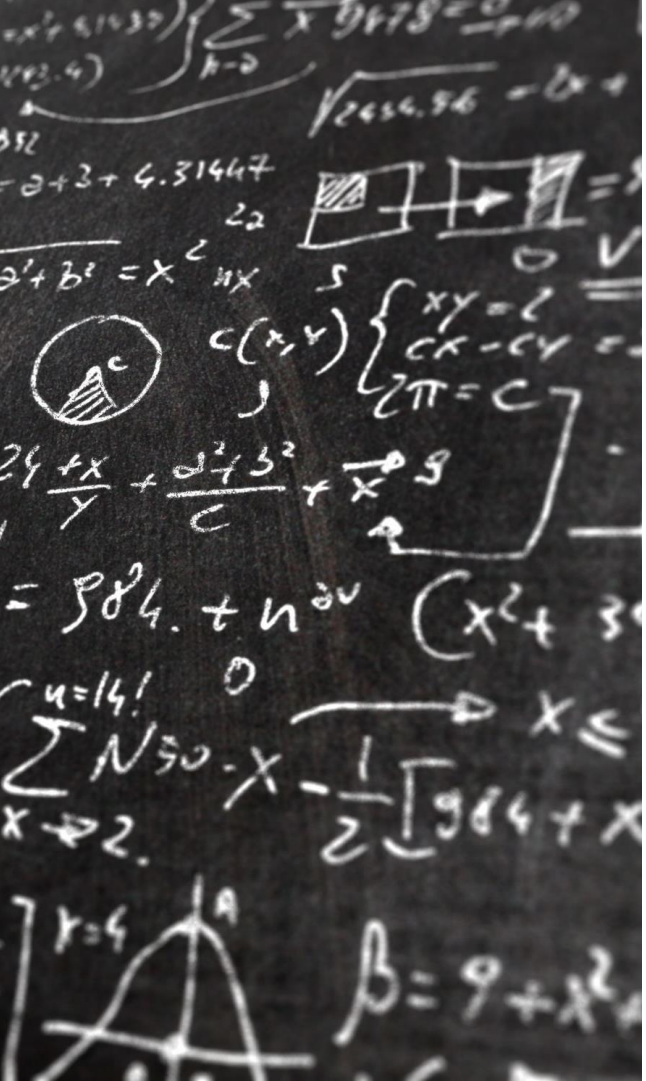
Developmental Math Students Views of Math

View math as rules/procedures to be memorized; can't "figure it out"

When students were asked, "What does it mean to be good at math?" 77% gave answers like these:

> "Math is just all these steps."
>
> "In math, sometimes you have to just accept that that's the way it is and there's no reason behind it."
>
> "I don't think [being good at math] has anything to do with reasoning. It's all memorization."

SOURCE: Stigler, et.al, "What Community College Developmental Mathematics Students Understand about Mathematics", *Math*AMATYC *Educator, May 2011*



Developmental Math Students: Approaches to Math

Interviewers asked students to work math problems.

Students' common-sense reasoning was short circuited by attempts to remember procedures and a compunction to calculate

SOURCE: Stigler, et.al, "What Community College Developmental Mathematics Students Understand about Mathematics", *Math*AMATYC *Educator, May 2011*

Which is greater: $\frac{a}{5}$ or $\frac{a}{8}$?

- 53% correct (about as good as guessing); very few could explain why

$$5a = a8$$

$$5 = 8 \checkmark$$

- Compulsion to calculate…

The role of teaching

Math teaching is a cultural activity, with more variability across countries than within a country.

But all high-performing countries shared a set of common features…

Source: TIMSS 1995 video study, Stigler, et.al.

Types of Learning Opportunities Required for Deep Understanding

For deep learning, with understanding, students need recurring and sustained opportunities for:

- Productive struggle - with important mathematics
- Explicit connections - among concepts, procedures, problems, situations
- Deliberate practice - increasing variation and complexity over time.

SOURCE: Stigler (2015)

High challenge requires high support

Ways to provide support:

- Communicating in all that we do and say that we believe in students' abilities to learn math
  - Positive feedback in public, constructive feedback in private
  - High expectations
- Backward design and just-in-time review
- Lots of low-stakes collaborative practice
- Attending to the affective side of learning

Backward Design & Just-in-Time Review

Backward Design

- Which type of math do students need for their chosen path-way? Align remediation to those specific college-level requirements.
- Statistics serves non-STEM majors, design with that in mind.

Just-in-time review

- An alternative to separating out and teaching discrete sub-skills in advance, this approach provides only the support students specifically need to grapple with challenging college-level tasks.
- We are not teaching all concepts from pre-transfer courses.
- We are not front-loading remediation. Instead, students are reviewing the algebra skills as they come up within the Statistics Curriculum
    - Example: Review rates of change and slope when covering linear regression and correlation.

Cuyamaca's Statistics Corequisite Just-In-Time Curriculum

Math Interludes:

I. Order of operations
II. Solving simple linear equations in one variable
III. Solving percentage problems
IV. Exponents, Scientific Notation, & Combining Like Terms
V. Dimensional Analysis (Unit Conversion)*
VI. Solving Formulas
VII. Rates of Change
VIII. Slope
IX. Slope-Intercept Form of a Line

*not a Stats concept - so why is it here?

View our corequisite just-in-time review materials

Cuyamaca's Statistics Corequisite Just-In-Time Curriculum

Planned just-in-time review:

- Each topic has premade lesson plans, worksheets, quizzes, and homework on Canvas.
- Deployed only when the time/need arises in the pacing of the course

Unplanned just-in-time review:

- Other topics pop up - every class is different
- Just a few students? Often handled during group discussions
- Most of the class? Impromptu mini-lecture
- We have more contact hours - this is what it's for!

Low-stakes collaborative practice

Low stakes opportunities to practice, get feedback, make mistakes and try again!

- Think-pair-share
- Speed dating
- Group work
- Ambassador exchange

Here is a toolbox of low-stakes collaborative practice activities to use in your classroom!

Attending to the Affective Domain

Students we are used to teaching in transfer-level classes:	• Freshmen who were very successful in high school • Second year students who know how to find resources and ask for help – they know the 'rules' of college
Students we will be teaching now in transfer-level classes:	• Freshmen who might have struggled with math in high school • Students who feel like they don't belong in the class/college • Students who don't know the 'rules' of college

How can we keep students engaged while attending to their affective needs?

Attending to the Affective Domain

01

Get to know your students and their individual needs - connect students with people, not just resources

Find out what your campus has to offer in terms of basic rights (food, housing, transportation).

02

Discuss feelings and attitudes towards math - normalize failures and celebrate mistakes.

03

Integrate affective domain assignments into your curriculum on topics such as Metacognition, Growth mindset, Grit.

Affective Domain Activities

04

Rethink policies and practices that make rebounding from failure impossible, or that don't allow for mistakes in the learning process.

Attending to the Affective Domain

Syllabus Policies: Redo's & Corrections

It's not about being perfect when you're learning. We make mistakes and fix mistakes, which is an important part of the learning process. In this class, you will have opportunities to redo or make corrections to every assignment.

What this looks like? Multiple attempts on Canvas quizzes, opportunities to submit drafts and get feedback from peers/teacher before grading, etc.

Attending to the Affective Domain

Syllabus Policies: Late Work

The need to turn in late work occurs for a variety of reasons. The important thing is to talk to me about it so that I can support you. *If you know that you are going to be absent or an emergency arises, please let me know and see if it is possible to turn in an assignment early or make it up on a different day. Homework will be due every week.* ***The best learning experience is one in which you keep pace with the posted due dates*** *on Canvas. Keeping pace helps you to digest the material with deeper understanding.* ***If you are not keeping up with the class, I will contact you to see how I can support you in this effort.*** *With the understanding that keeping up with the work is what is best going to support your learning,* ***I understand that life happens and sometimes it is not possible to get something done by the due date.*** *Don't be worried if you miss something. Please send me a message and we can discuss a plan to get you back on track.*

What this looks like? I reach out to students before things are due and again after if they didn't turn something in. I offer support. If a due date is strict, I provide a rationale.

A typical day in the corequisite statistics classroom

Statistics with Corequisite Support at Cuyamaca College

- Started Fall 2016
- Designated sections of 4-unit Statistics course linked to 2-unit support course taught by the same instructor in back-to-back time slots. Contact hours: 6 hours a week
- Placement
  - Statistics without support: H.S. GPA > 2.8 (self-reported)
  - Statistics with support: Open to everyone
- Class max: 42 students
- Grading: two separate grades, corequisite is Pass/No Pass.
- Peruse my syllabus

Overview of how other colleges set up corequisite classes.
(Warning: this document is from 2018, many colleges have broadened access and added new courses since)

The Student-Centered Classroom

“New” students = new way of teaching.

The focus of activity shifts from the teacher to the learner, and class time is spent on:

- Discussion
- Collaborative work
- Productive struggle, and
- Contextualized just-in-time review

The Statistics Lesson

MODULE 19: ESTIMATING A POPULATION PROPORTION

Learning Objectives:

- Constructing a confidence interval for p
- Putting it all together: the four-step process
- How does the confidence level affect the confidence interval?

Small Group Student Warm Up

1. What is the formula for constructing a confidence interval about a proportion? And what do we use a confidence interval for?

2. A New York Times/CBS News Poll asked the question, "Do you favor an amendment to the Constitution that would permit organized prayer in public schools?" Sixty-six percent of poll answered "Yes." The article gives the margin of error for a 95% confidence level as 3 percentage points.
   a) Explain what the margin of error means to someone who knows little about statistics
   b) State the 95% confidence interval.
   c) Interpret the confidence interval.

Time Stamp: 10 minutes
7 mins working
3 mins report out

Mini-Lecture

Teacher connects the Margin of Error (MOE) to the critical values and the standard deviation formula.

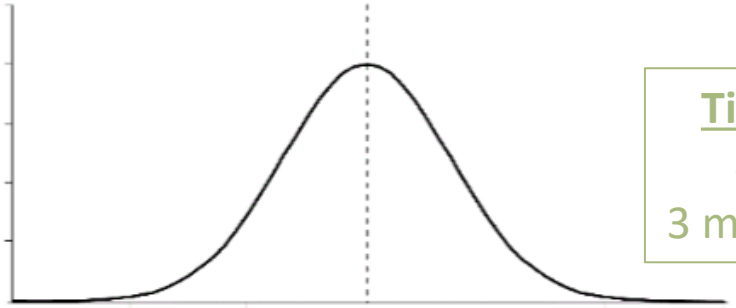
Students use applets and the standard normal distribution to find common critical values.

The equation for a confidence interval for a proportion has been given as $\hat{p} \pm$ margin of error. We have been given the standard errors. How do we calculate the standard error?

Standard error = (critical value)(standard deviation of statistic)

Standard deviation of statistic = $\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

How do we find the critical value? If the normal condition is met, we can use a Normal curve. If you remember, we used the 68-95-99.7 rule for Normal Distributions and used 2 for an approximate 95% confidence interval. We will now use a more accurate number from either an applet or calculator.



Time Stamp: 7 minutes

4 mins of discussion

3 mins of students working

3. Gimme a Kiss! Hershey's Kisses and Confidence Intervals

In this activity, we will estimate a confidence interval for the proportion of times a Hershey's kiss lands on its base as opposed to its side. To do this, we will drop Hershey's kisses, count how many land on their base, and calculate the confidence interval.

To take your sample, gather five Hershey's kisses in your cup, shake them up, and drop them from about six inches above your desk. Count the number that land on their base.

Repeat ten times to get a sample of size 50, recording your results in the table below.

Toss Number	Number that land on base	Toss Number	Number that land on base
1		6	
2		7	
3		8	
4		9	
5		10	

Total _____

" I got the instructions from my Statistics Professor. He was 80% confident that the true location of the restaurant was in this neighborhood."

What is the population of interest? _____

What is the sample? _____

Your result (50 tosses combined): $\hat{p}$ =

Compare your $\hat{p}$ with the other groups. Did you all get the same answer? _____

Make a 95% confidence interval based on your result. Before you start, make sure the three conditions are met.

Group Activity

Group Activity: Gimmie A Kiss

Read through the prompt as a whole class.

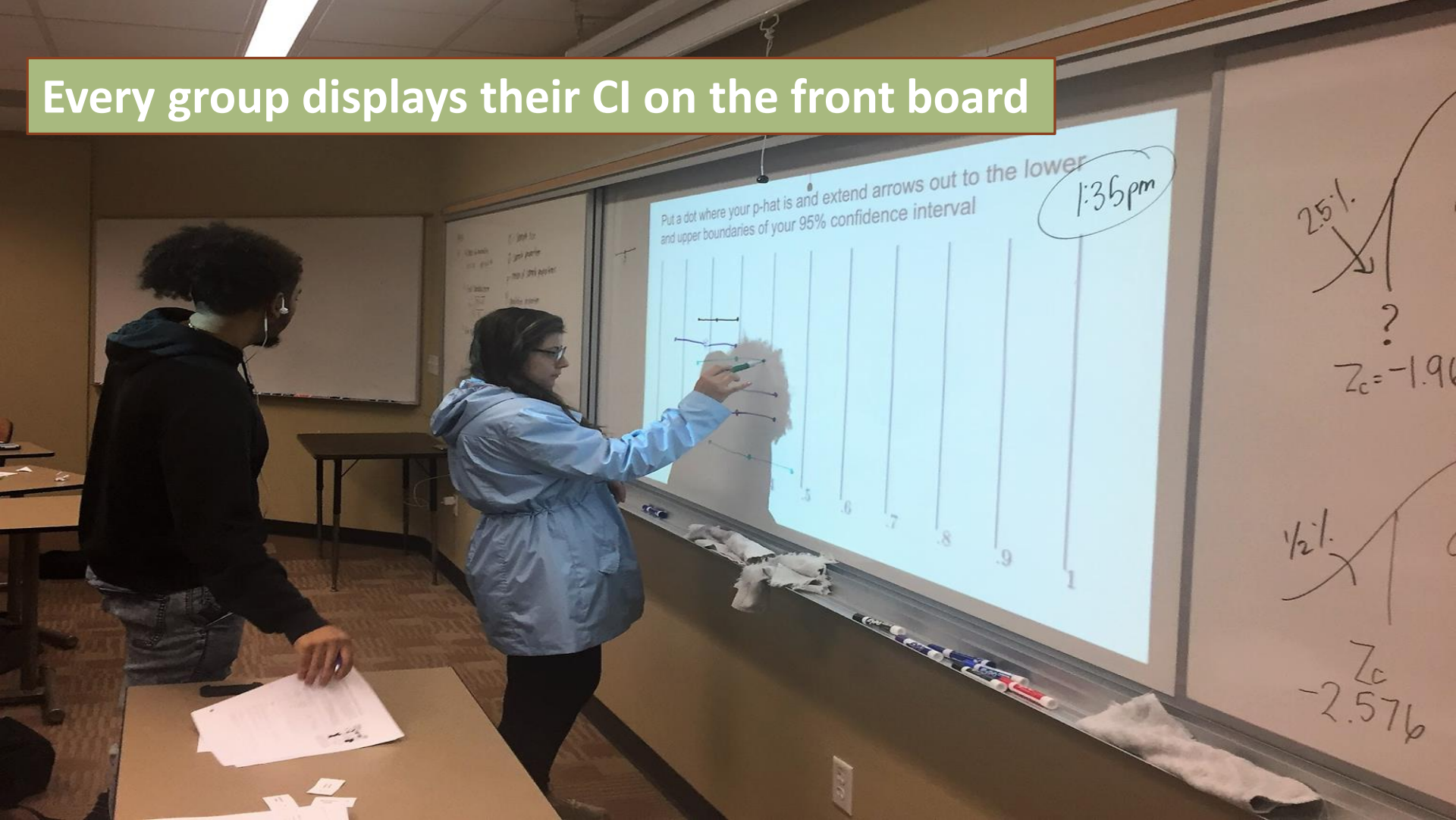
Students work in groups to “collect data” and make their confidence intervals.

Time Stamp: 20 minutes

5 mins of set-up

15 mins of students working

Every group displays their CI on the front board



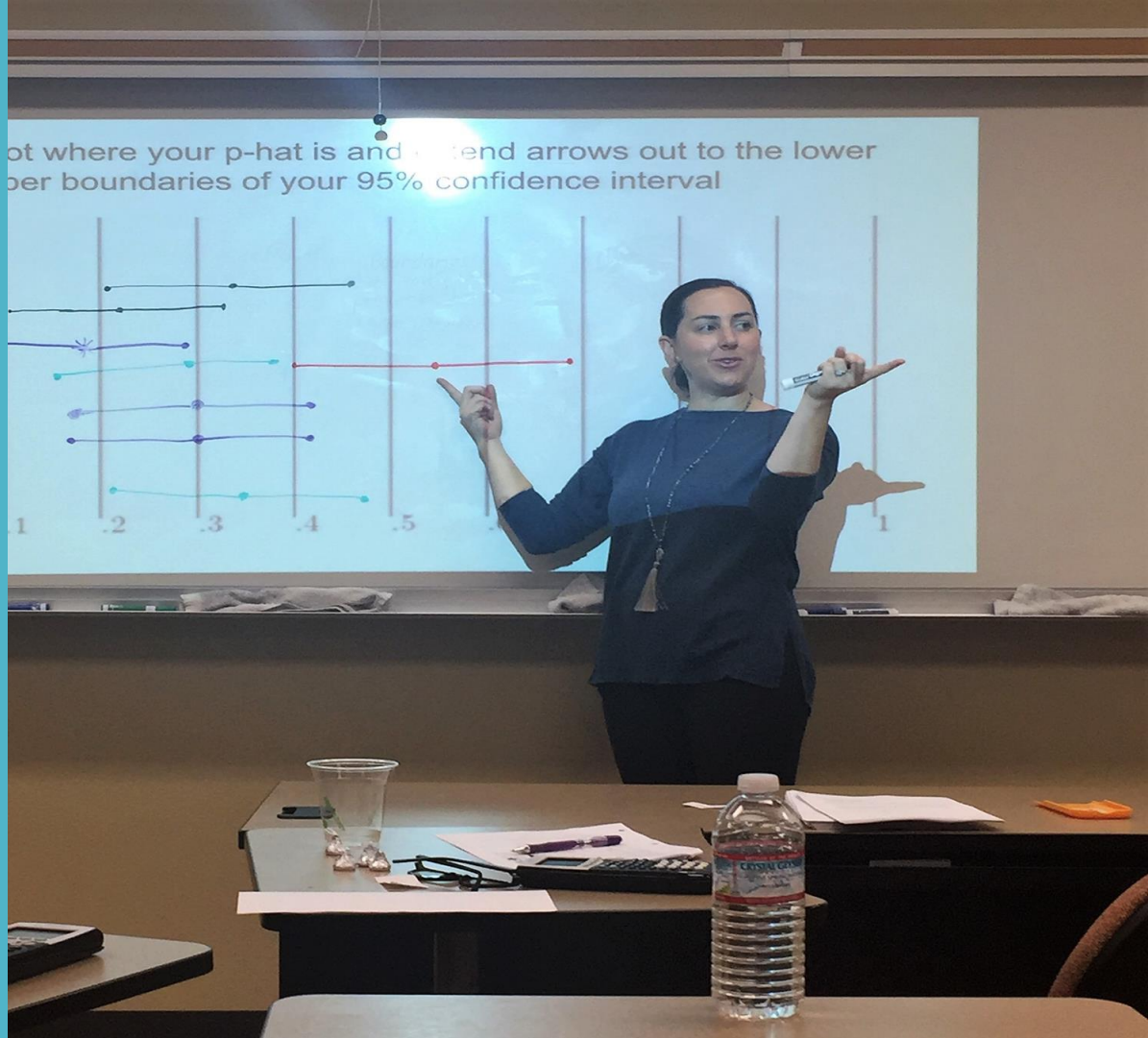
Closure: Whole Class Discussion

Teacher-led discussion:

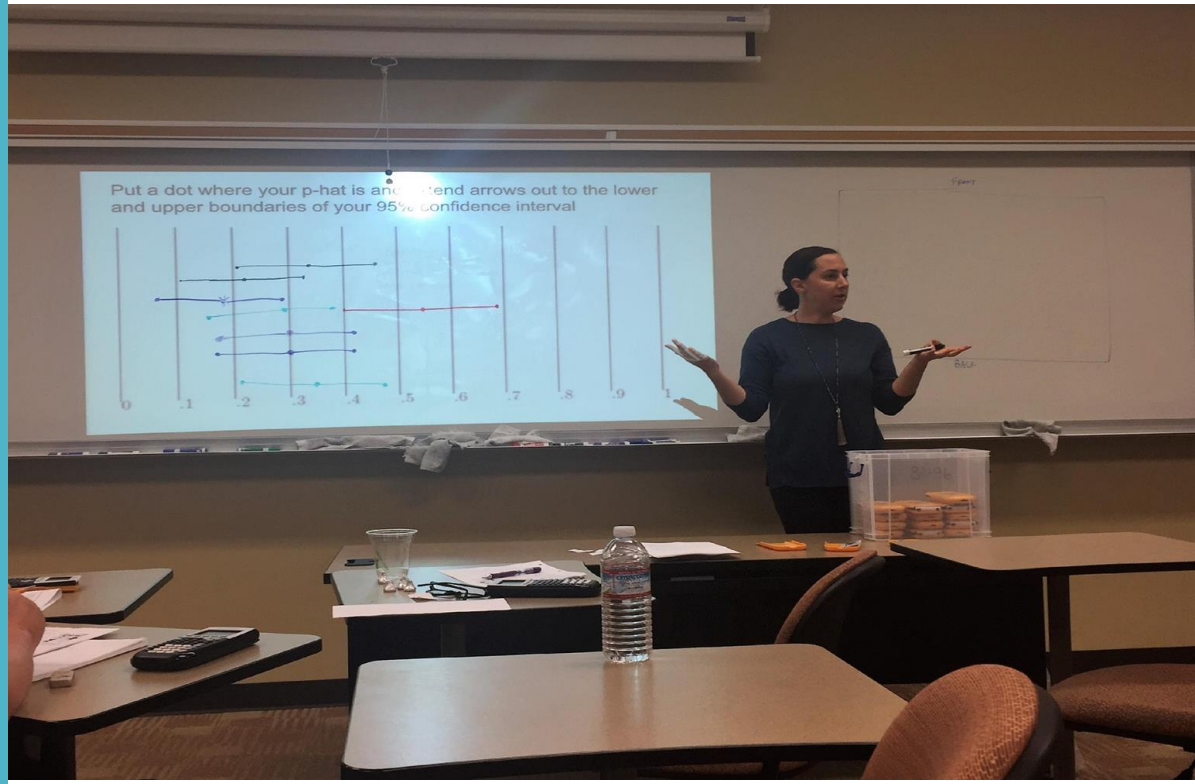
- Compare and contrast Confidence Intervals between groups.
- Discuss the goal of a Confidence Interval

Time Stamp: 10 minutes
10 mins of discussions and questions & big picture

“Did every group get the same sample proportion? Is that normal? Why or why not?”



“Do you know for sure that the true population proportion exists within your groups’ CI?”



Next Up: Low-Stakes Collaborative Practice

Teacher sets up the problems by talking about the “four-step process” for CI’s – connecting it to what we just did in the Gimmie A Kiss Activity.

- State: What are you trying to find and at what CL
- Plan: Check conditions - Normal? Random?
- Do: Calculate
- Conclude: Interpret your CI

Time Stamp: 5 minutes
Teacher mini-lecture

Low-Stakes Collaborative Practice

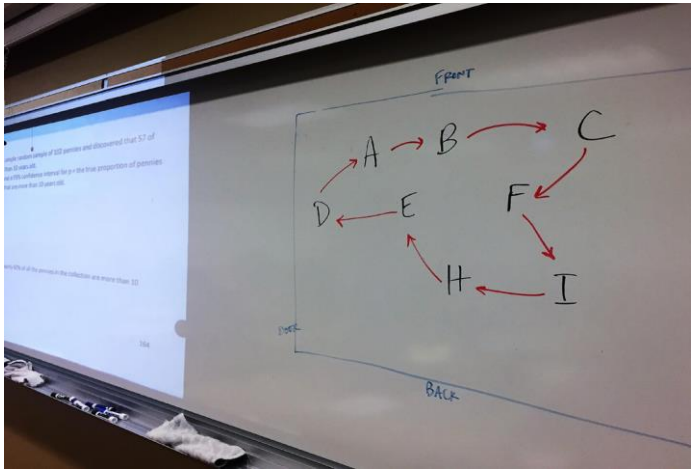
Students work in *new* groups on more traditional “textbook” problems.

Teacher is wandering among groups: answering questions, looking for common mistakes/stumbling blocks to bring up in closure, gaging if just-in-time review is needed.

Time Stamp: 15 minutes
Students working

Low-Stakes Collaborative Practice

After about 10 minutes of working, an ambassador exchange happens so groups can check in with each other.



Closure: Whole Class Discussion

As groups finish early, they are asked to put their work on the boards.

Closure:

- Students
  - *analyze the work of their peers*
  - *Offer corrections*
  - *Ask questions*
- Teacher facilitates the discussion

Time Stamp: 10 minutes
Closure Discussion

Did I Get This? – Time for Individual Work

With a break added in the middle somewhere, there is about 30 minutes left in class.

Students are currently organized into groups of 3. Everyone in the class gets the same problem prompt but each group member is asked to calculate using a different confidence level (90%, 95%, and 99%).

Jigsaw: Regrouped by common confidence levels. Students compare answers and help each other.

Time Stamp: 20 minutes
10 mins of Individual Work
10 mins of Jigsaw

Closure: Individual Work

No whole class discussion of the problems – all issues should have been worked out in the jigsaw.

Each group reports their CI. Teacher writes them on the board.

Exit Ticket Journal Prompt:

> "What happened to the confidence intervals as we changed the level of confidence? Why do you think this happened?"

Time Stamp: 10 minutes
3 mins of Report Out
7 mins of Exit Ticket

Easy, right?

Wrong! I cried a lot during those first few months.

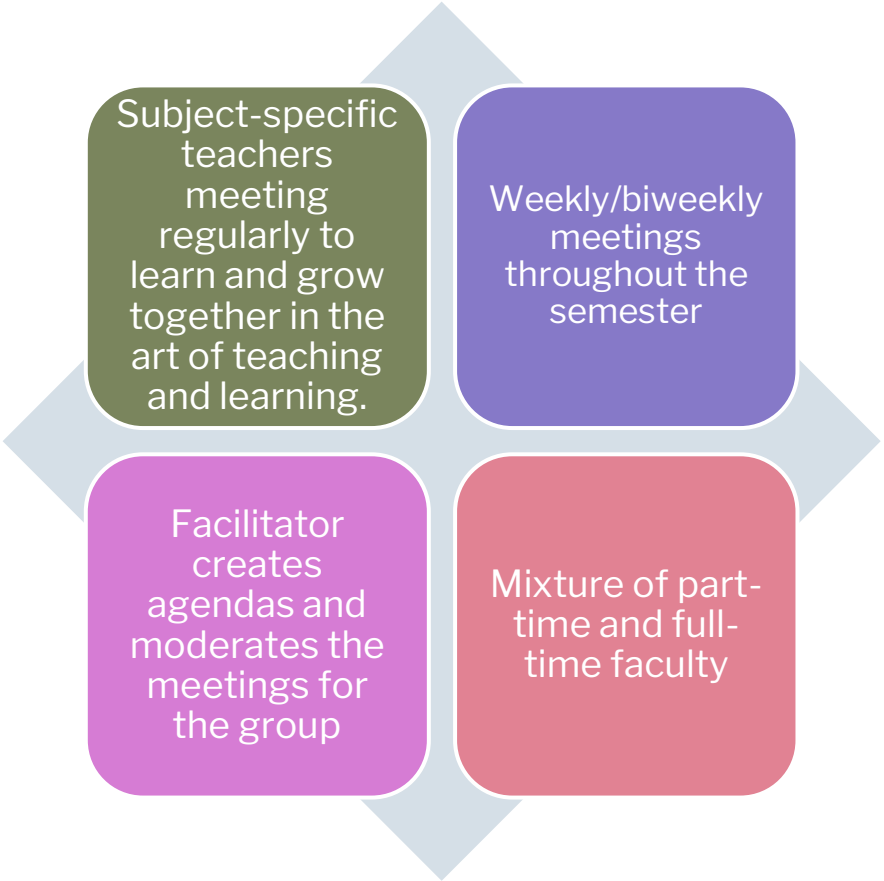
Lessons learned:

- We were expecting all of these changes and we were prepared for these changes, but students were not.
- We had all of the lesson plans and materials we could have dreamed for, but our cookie-cutter lesson plans didn’t allow for personal teaching styles and preferences
- We were trying something new and different (just like our students). We needed to know that mistakes and failures were normal (just like our students). And we needed support (just like our students).

Supporting Faculty with a Community of Practice

Community of Practice (COP)

“Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.” (Wenger-Trayner, 2015)



COP in the Math Department at Cuyamaca College

Ongoing Support Through a COP

Goals for COP:

- Change expectations of faculty
- Support implementation of pedagogical reforms
- Provide intentional support for the affective domain of our faculty

Attending to the Affective Domain of our Faculty

Address the fears of the faculty

Safe environment for full-time and part-time faculty

Pay people for their time

Community of Practice Meetings

Common Agenda Items

- Classroom management
- Lesson plan review and revision
- Subject matter training for faculty
- Assessments
- Support for affective domain (students & faculty)
- Student engagement and retention
- Exploring instructor biases

Change is scary. But change is needed.

“Seeing that I could change and that the change that I made was more effective and more helpful... I'm really happy that I got the opportunity for it.”


SOULPANCAKE

Resources

Suggested Readings:

- Toward A Vision of Accelerated Curriculum & Pedagogy
- Math Corequisite Models & Lessons Learned
- The College Fear Factor & Laziness Does Not Exist

Class Materials:

- Lesson plans for an interactive corequisite statistics classroom
- In-class worksheets and activities
- Corequisite just-in-time review materials
- Group tickets for randomized groups of 3
- Affective Domain Activities
- Low-stakes collaborative practice activities
- Canvas Courses

Questions?

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