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# Mastery-Based Grading in Higher Education

## Improving student learning, increasing student motivation, and recapturing the joy of teaching by grading differently

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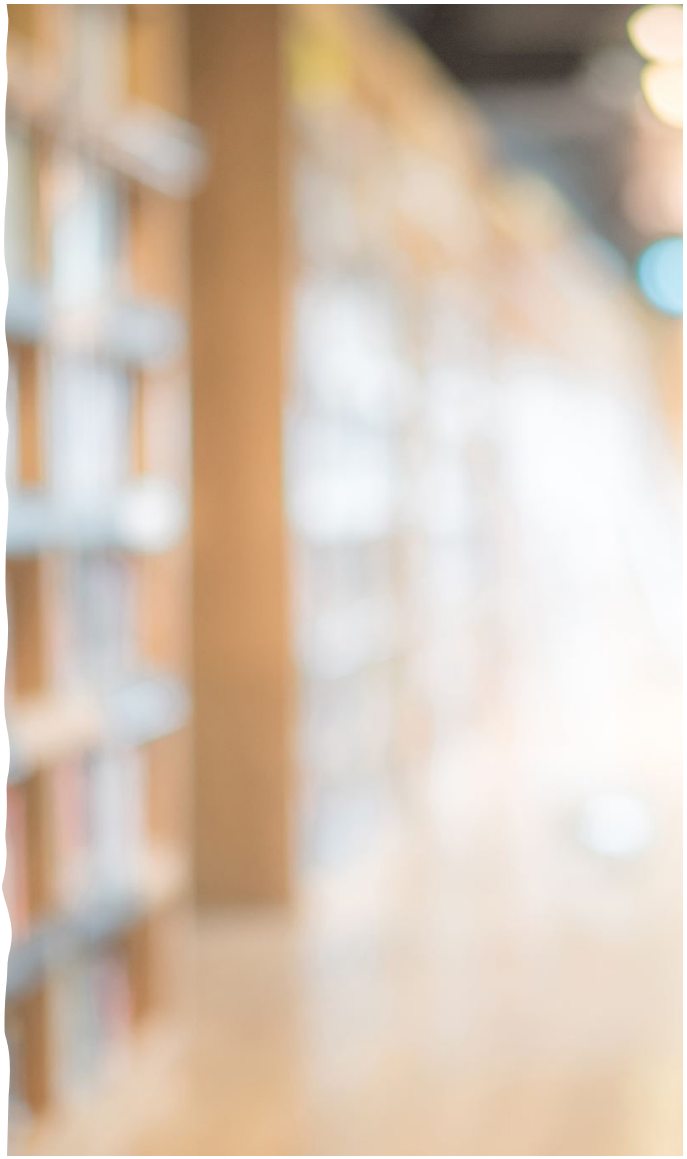
What experience do you want to have as a teacher in a classroom?

What kinds of conversations would you like to have with students?



# Why look at our grading policies?

## Traditional Grading

- Students have difficulty knowing how they are doing
- Students struggle to compute their current or future course grade
- Giving meaningful advice can be difficult and time-consuming (and students often ignore it)
- Lots of lost information (why DID I give 7 points instead of 6?)
- Accumulation of partial credit without mastery

"Grades should reflect **demonstrated mastery of course content** and have a positive effect on student **learning**."

—Kate Owens
College of Charleston

"What you **assess** is what they learn."

—Sharona Krinsky
Cal State Los Angeles

# What is Mastery Grading?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Mastery Grading is an approach to grading that involves three key features:

A clear list of learning targets, objectives or **standards**.

**Assessment of mastery** instead of points or partial credit.

**Eventual mastery** matters.

Adapted from **Introduction to Mastery Grading**

# Core ideas of Mastery Grading

- Opportunity to “fail forward”
- Encourages a growth mindset
- Student autonomy
- Flexible ways of demonstrating mastery
- Removes the instructor as the gatekeeper of the points.

# Our Experience with Mastery Grading

## Jointly: Redesigned Quantitative Reasoning with Statistics (2017-2018)

- General Education course taught primarily by adjunct instructors
- Many sections (50 – 80 in Fall semester, fewer in Spring)

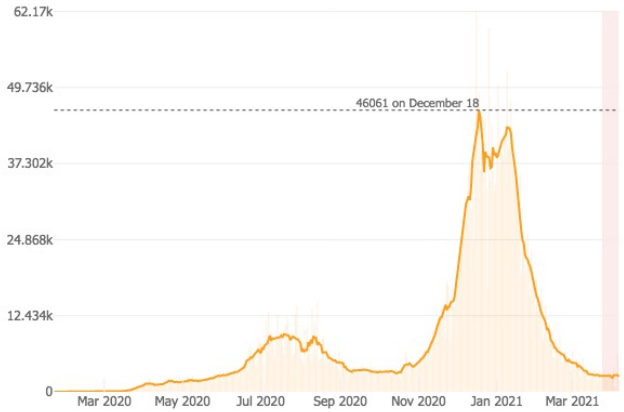
## Sharona: Linear Algebra & Calculus courses

- Mastery grading in conjunction with Inquiry-based learning using *Linear Algebra for Team-Based Inquiry Learning* and *Active Calculus* online texts

# Questions to Ask when Implementing Mastery Grading

- What are the standards I want students to master? That is, what do I want students to know when they leave my class?
- Do my standards align with the course learning objectives?
- What types of assessments do I want to use to know whether students have mastered a standard?
- Do I want to use the same type of assessments for an additional opportunity to master the standard?
- How many additional attempts at mastery do I want to allow?

# Example: Quantitative Reasoning with Statistics



COVID-19 confirmed cases in California

11 Statistics Standards*

3 Mathematical Practice Standards

One $P^3$ "Habits of Mind" Standard

A - Master 13 or more standards

B - Master 10 or more standards

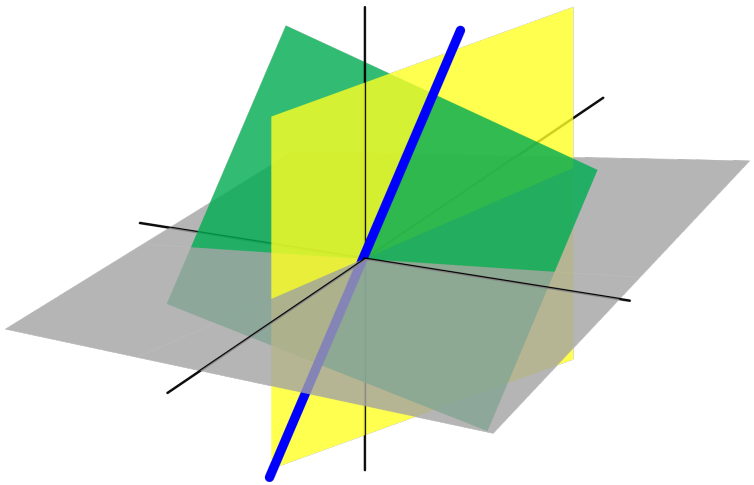
C - Master 9 or more standards

* This is our fourth iteration of the grading architecture. We needed to "master" Mastery Grading!

# Example: Quantitative Reasoning with Statistics

- To master a **statistics standard** or a **mathematical practice standard** get a ✓ on two mastery assessments
  - Portfolio style homework assignment
  - Initial Quiz and two requizzes
  - Final
- To master the **$P^3$ Standard** - Get 900 or more points (out of at least 1200 available).

# Example: Linear Algebra



24 Linear Algebra Standards

4 Mathematical Practice Standards

One $P^3$ "Habits of Mind" Standard

A - Master 26 or more standards

B - Master 23 or more standards

C - Master 20 or more standards

# Example: Calculus

17 Calculus Standards

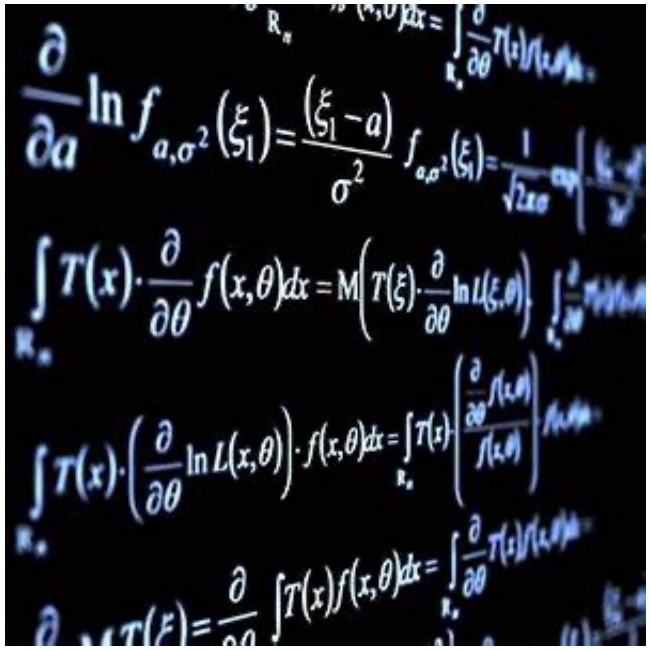
7 Mathematical Practice Standards

One $P^3$ "Habits of Mind" Standard

A - Master 24 or more standards

B - Master 21 or more standards

C - Master 18 or more standards



# Interlude: What Constitutes Mastery?

Assess whether a student can find the terms of a sequence defined implicitly or explicitly.

- Describe the first four terms of the following sequence
- $a_{n+1} = \begin{cases} 2a_n - 1, if\ a_n\ is\ even \\ 3a_n + 1, if\ a_n\ is\ odd \end{cases}, a_1 = 6$
- Correct Work:
  - $a_1 = 6, a_2 = 2(6) - 1 = 11, a_3 = 3(11) + 1 = 34, a_4 = 2(34) - 1 = 67$

# What grade would you give these two students?

**SLO:** Student can find the terms of a sequence defined implicitly or explicitly.

- Describe the first four terms of the following sequence
- $a_{n+1} = \begin{cases} 2a_n - 1, if\ a_n\ is\ even \\ 3a_n + 1, if\ a_n\ is\ odd \end{cases}, a_1 = 6$
- Correct Work:
  - $a_1 = 6, a_2 = 2(6) - 1 = 11, a_3 = 3(11) + 1 = 34, a_4 = 2(34) - 1 = 67$

**Typical incorrect work:**

A

- $a_2 = 2(6) - 1 = 11$
- $a_3 = 2(11) - 1 = 21$
- $a_4 = 2(21) - 1 = 41$

- $a_2 = 3(6) + 1 = 19$
- $a_3 = 3(19) + 1 = 58$
- $a_4 = 3(58) + 1 = 175$

B

- $a_2 = 2(6) - 1 = 11$
- $a_3 = 3(11) - 1 = 33$
- $a_4 = 3(33) + 1 = 100$

Problem graded out of 10 points. Grade for A _____ Grade for B _____

# Have the students achieved mastery?

**Standard:** I can find the terms of a sequence defined implicitly or explicitly.

- Describe the first four terms of the following sequence
- $a_{n+1} = \begin{cases} 2a_n - 1, if\ a_n\ is\ even \\ 3a_n + 1, if\ a_n\ is\ odd \end{cases}, a_1 = 6$
- Correct Work:
  - $a_1 = 6, a_2 = 2(6) - 1 = 11, a_3 = 3(11) + 1 = 34, a_4 = 2(34) - 1 = 67$

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- $a_2 = 2(6) - 1 = 11$
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- $a_2 = 3(6) + 1 = 19$
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- $a_4 = 3(58) + 1 = 175$

B

- $a_2 = 2(6) - 1 = 11$
- $a_3 = 3(11) - 1 = 33$
- $a_4 = 3(33) + 1 = 100$

Grade for A _____

Grade for B _____

# Alignment of Assessments and Standards

How do students A and B differ in their understanding of the standard?

- A had comprehension mistakes on concept
- B applied the recursion correctly, but made an arithmetic mistake

Which one is important?

What is the role of technology, especially in remote learning?

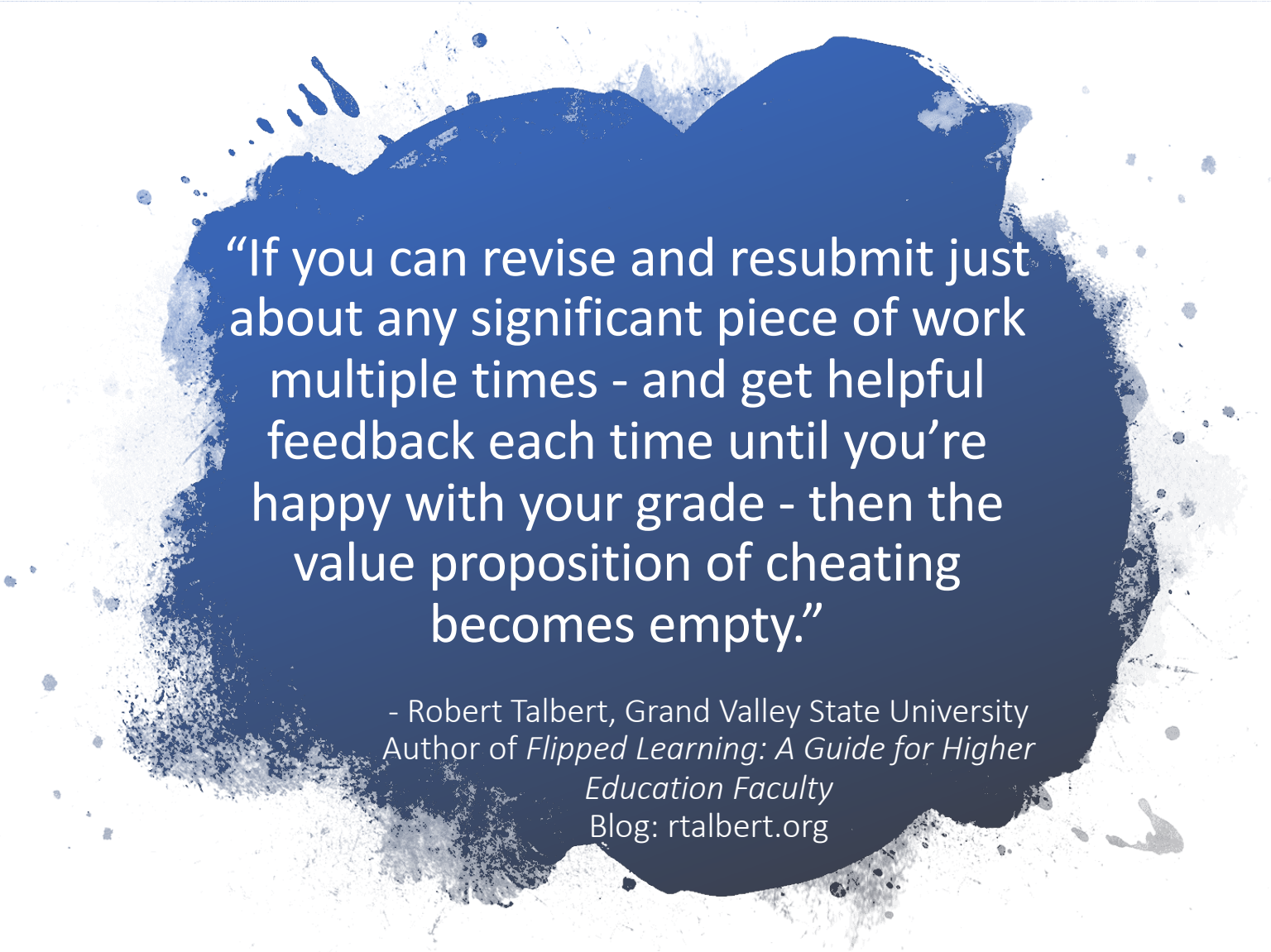
# How has this worked in practice?

## GE Statistics

- In use since Fall 2018.
- 5,000+ students
- Student's comments on final project indicate that they have learned to be critical consumers of stats
- Plan for study on subsequent courses
- Anecdotal evidence: Low rate of cheating on Chegg

## Calculus/Linear Algebra

- In use since Spring 2017.
- 14 courses in the Calculus sequence and Lower Division Linear Algebra
- 425+ students
- Pass rate over 80%, most with A's and B's
- Students report never having worked harder and have pushed through their learning longer than in other classes
- Lots of conversations about "math"


“If you can revise and resubmit just about any significant piece of work multiple times - and get helpful feedback each time until you’re happy with your grade - then the value proposition of cheating becomes empty.”
- Robert Talbert, Grand Valley State University
Author of *Flipped Learning: A Guide for Higher Education Faculty*
Blog: rtalbert.org

# Handling the Grading Load

- Deciding on mastery vs. not mastery takes less time
- However, feedback takes more time
  - Goal-oriented (action verbs)
  - Specific
  - Timely
- The more that students master earlier, the lower the grading load.

Photo by Agence Olloweb on Unsplash


## Want to learn more?

## Mastery Grading Conference
## June 11 & 12, 2021

www.masterygrading.com

- Online via Zoom
- Registration: $10, FREE for students

Last year, over 500 Math and STEM faculty from around the country (and in some cases the world) attended a 2-day online conference.

# Join the Community

- Mastery Grading Slack Channel (link on resources page at www.masterygrading.com)
- Twitter
  #MasteryGrading
  @SouthBaySharona
  @KateOwens
  @dccmath (Dave Clark)

# Thanks!

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# Do you have any questions?

# References

- www.masterygrading.com (links to lots of other resources)
- Special Issue of PRIMUS on Mastery grading (https://www.tandfonline.com/doi/full/10.1080/10511970.2020.1778824)
- Special Collection of PRIMUS articles on assessment (https://primusmath.com/curated-collections/curated-collection-assessment/)
- Blog by Robert Talbert rtalbert.org

Textbooks mentioned and other books

- https://teambasedinquirylearning.github.io/linear-algebra/frontmatter.html
- ActiveCalculus.org
- Linda B. Nilson, Specifications Grading