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?

Photo by Firmbee.com on Unsplash
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

11 Statistics Standards*

3 Mathematical Practice Standards

One P³ “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!

COVID-19 confirmed cases in California
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 **P³ Standard** - Get 900 or more points (out of at least 1200 available).
Example: Linear Algebra

24 Linear Algebra Standards
4 Mathematical Practice Standards
One P³ “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 P³ “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

\[ a_{n+1} = \begin{cases} 
2a_n - 1, & \text{if } a_n \text{ is even} \\
3a_n + 1, & \text{if } a_n \text{ is odd}, \quad a_1 = 6
\end{cases} \]

- Correct Work:

\[ a_1 = 6, \quad a_2 = 2(6) - 1 = 11, \quad a_3 = 3(11) + 1 = 34, \quad a_4 = 2(34) - 1 = 67 \]
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
- \[ a_{n+1} = \begin{cases} 2a_n - 1, & \text{if } a_n \text{ is even} \\ 3a_n + 1, & \text{if } a_n \text{ is odd} \end{cases}, \ a_1 = 6 \]
- 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:**

- \[ a_2 = 2(6) - 1 = 11 \]
- \[ a_3 = 2(11) - 1 = 21 \]
- \[ a_4 = 2(21) - 1 = 41 \]

- \[ a_2 = 3(6) + 1 = 19 \]
- \[ a_3 = 3(19) + 1 = 58 \]
- \[ a_4 = 3(58) + 1 = 175 \]

- \[ a_2 = 2(6) - 1 = 11 \]
- \[ a_3 = 3(11) - 1 = 33 \]
- \[ a_4 = 3(33) + 1 = 100 \]

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

\[ a_{n+1} = \begin{cases} 2a_n - 1, & \text{if } a_n \text{ is even} \\ 3a_n + 1, & \text{if } a_n \text{ is odd} \end{cases}, \quad a_1 = 6 \]

**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:**

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

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

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](http://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](http://www.masterygrading.com) (links to lots of other resources)
• Special Issue of PRIMUS on Mastery grading
• Special Collection of PRIMUS articles on assessment
• Blog by Robert Talbert [rtalbert.org](http://rtalbert.org)

Textbooks mentioned and other books
• [https://teambasedinquirylearning.github.io/linear-algebra/frontmatter.html](https://teambasedinquirylearning.github.io/linear-algebra/frontmatter.html)
• [ActiveCalculus.org](http://ActiveCalculus.org)
• Linda B. Nilson, Specifications Grading