Getting Started with Mastery Grading

AAC&U Transforming STEM Higher Education
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Introductions

Mastery-Based Testing

Specifications Grading

Benefits of Mastery Grading
Introductions
In your groups, please share:

- Your name
- Your institution
- One thing you’ve heard about mastery grading/standards-based grading
- A possible target course for mastery grading
Think-Pair-Share:

What is the purpose of a course grading system?
Mastery-Based Testing
Think-Pair-Share:

What (if any) purpose do you think the assessment examples in the given handouts fulfill?
Mastery-Based Testing (MBT)

**Typical Implementation.**

- Assessments consist of one question per objective.
- Assessments include all objectives encountered in the course up to that point.
- Students select which problems they want to attempt.
- Solutions are graded for mastery (no partial credit).
- A student’s grade depends on the number of objectives mastered by the end of the course, regardless of the number of attempts required.
T.1 I can convert between degrees and radians; I can identify and describe special angles in degrees and radians.

T.2 I can use the unit circle to find the values of the trigonometric functions at the special angles.

T.3 I can use right triangle trigonometry.

T.4 I can solve equations involving trigonometric functions.

T.5 I can solve inequalities involving trigonometric functions.
T.1 I can convert between degrees and radians; I can identify and describe the special angles in degrees and radians.

1. Express the angle $\frac{4\pi}{3}$ radians in degrees.
2. Sketch this angle on the unit circle.

T.4 I can solve equations involving trigonometric functions.
Find the values of $\theta$ in the interval $[0, 2\pi]$ for which $1 - 2 \cos \theta = 0$.

T.5 I can solve inequalities involving trigonometric functions.
Find the values of $\theta$ in the interval $[0, 2\pi]$ for which $2 \sin \theta - \sqrt{3} < 0$. 
When MBT makes sense

- Core content objectives
- Short answer questions
- Large collection of questions at a comparable level
- Know/Understand questions (Bloom’s Taxonomy)
Getting started with MBT

- Identify list of objectives
- Generate question bank
- Set up testing system
  - How many in-class assessments will you have?
  - Will you allow retakes in office hours or elsewhere?
  - Will you limit the number of retakes? How?
  - Will you give students chances to earn bonus retakes?
- Integrate results into your grading system
Specifications Grading
Think-Pair-Share:

For your target course, come up with:

- One objective that could be tested using mastery-based testing
- One objective that would be difficult to test using mastery-based testing
### Typical Implementation.

- For each assignment, the instructor provides specifications describing what a successful submission would look like.
- Mastery is achieved when a submission meets all of the specifications.
- Assignments are graded for mastery (no partial credit).
- Students have (or may earn) multiple opportunities to revise assignments or reattempt them in order to meet the specifications.

Adapted from *Definitions for PRIMUS special issue on Mastery Grading*
Syllabus Statement

To demonstrate your ability to apply the mathematical content of this course to solve problems that model real-world situations, you will have the opportunity to submit solutions to two applied problems. In order to earn a grade of A, you must submit one correct solution from each of the following categories:

1. Linear Functions
2. Exponential Functions.

If you include fewer than two categories, then your final grade will be determined as described in the grading chart.
Specifications

In order to earn a pass on an applied problem, your solution or proof must be both **correct** and **properly formatted**. In particular, it should meet all of the following specifications:

- The solution is neatly hand-written or typed, using complete sentences.
- The solution is written at a level that is appropriate for a Math 159 audience, namely, members of our class who are familiar with the content of the course but who may not have worked on the particular problem whose solution you are presenting.
- The solution is correct and the steps in the solution are also correct.
- Mathematical notation and terminology is used properly.
**Problem**

1990, 68\%
2015, 80\%

(a) Find P.

(b) When are they equal?

**Solution**

(a) \((0, 68), (25, 80)\)

\[
m = \frac{80 - 68}{25 - 0} = \frac{12}{25}
\]

\[
P - 68 = \frac{12}{25} (t - 0)
\]

\[
P(t) = \frac{12}{25} t + 68
\]

(b)

\[
\frac{12}{25} t + 68 = 100
\]

\[
\frac{12}{25} t = 32
\]

\[
t = 32 \left(\frac{25}{12}\right) = \frac{200}{3} \approx 67.
\]
Since the founding of the Equal Employment Opportunity Commission and the passage of equal pay laws, the gulf between men's and women's earnings has continued to close gradually. At the beginning of 1990, women's wages were 68% of men's wages, and by the beginning of 2015, women's wages were 80% of men's wages.

(a) Based on these data points, find a linear equation that gives \( P \), the percentage of men's earnings that women's earnings are \( t \) years after 1990.

Let \( P(t) \) be the percentage \( t \) years after 1990. We are told that \( P(0) = 68 \) and \( P(25) = 80 \). (Note that 2015 is 25 years after 1990.) Thus, \((0,68)\) and \((25,80)\) are two points on the graph of \( P \). This means that the slope of \( P \) is

\[
m = \frac{80 - 68}{25 - 0} = \frac{12}{25}.
\]

Using the point \((0,68)\), we then see that

\[
P(t) - 68 = \frac{12}{25} (t - 0),
\]

so

\[
P(t) = \frac{12}{25} t + 68.
\]
When does specs grading make sense?

- More complicated problems or tasks
- Assessing beyond core content
- Apply/Analyze/Synthesize/Evaluate questions (Bloom’s Taxonomy)
Getting started with specs grading

- Identify appropriate assignments or tasks
- Identify the desired student outcomes
- Craft the specifications to highlight your desired outcomes
- Set up submission system
  - How will students turn in submissions?
  - How many resubmissions will you allow?
  - How will you collect resubmissions?
- Create a rubric that reflects your specifications to aid with feedback
Think-Pair-Share:

For your target course,

- Adapt a current assignment to a Specifications Grading system, or
- Outline a new assignment that could be assessed with a Specifications Grading System.
Benefits of Mastery Grading
Benefits for Students

- Recognizes and supports the learning process
  - Students are graded on what they eventually know
  - Interleaving, spacing, and repeated retrieval arises naturally

- Promotes a growth mindset
  - Students get to learn from mistakes and build upon failures
  - Students experience a series of successes, both small and large
  - Sets up an expectation of success for all students

- Gives students more choice and agency
  - Students can choose what they will complete
  - Students are assessed when they feel ready

- Students’ grades reflect their understanding of the course material
  - They can see what they do and don’t understand
Benefits for Faculty

- More efficient grading
  - No partial credit
  - Clear expectations
- Maintain high standards
  - Clear specifications
  - Submission-feedback-revision-resubmission cycle
- More effective interactions with students
  - Focused office hour questions
  - Clear paths to success
  - Common understanding of course goals
  - Current information about student progress
- Deeper recognition of course goals
Integrating mastery grading into your grading system

You can customize it!

- Make it part of a traditional grading system using points.
- Make your entire grading system mastery-based.
Additional Resources

- Google Drive Resources
  - Math Resources goo.gl/6wMAHb
  - Physics Resources bit.ly/PhysicsMBGRepository

- Mastery Grading group on Slack
  Email one of us to get an invitation to join

- Upcoming Workshop on Mastery Grading in Mathematics
  www.masterygrading.com

- Feel free to contact us:
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