Implementing Standards Based Grading in STEM

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For Our Future Conference
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Metrics

Question

What do you **want** grades to measure?

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   - Life.

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- How long it took a student to learn the material.
- How well a student is making the transition from high school to college.
- When a student had a bad day.
- How adept a student is at stringing together partial credit.

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  - Failure is part of the learning process.
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  - This is only possible if students are **not** doomed to failure by past mistakes.

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- **M**
- **P**
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- Once a student has earned an **M**, they stop seeing problems from that standard on reassessments.
  - ⚠Later standards are constructed to build on early standards. If this is not feasible, you may want to utilize a comprehensive final exam.

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Example Standard (Linear Algebra)

Systems of Equations 1: I can

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- identify whether or not a matrix is in Reduced Row Echelon Form,
- use Gaussian Elimination to put a matrix into Reduced Row Echelon Form,
- use the Reduced Row Echelon Form of an augmented matrix to describe the solution space to a system of linear equations using appropriate notation.

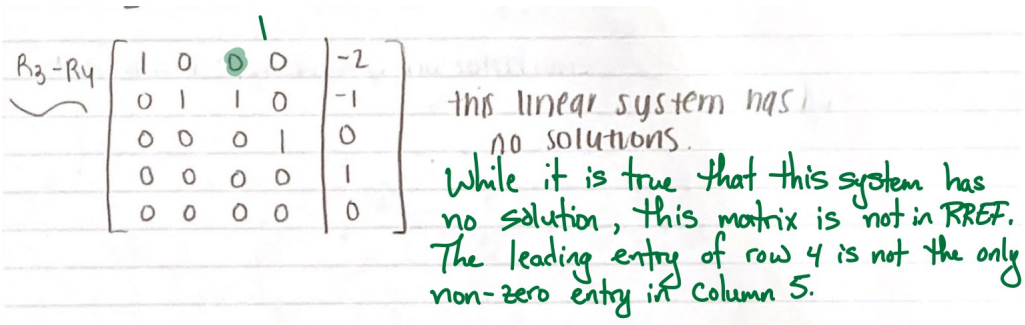
An Implementation

Example (Linear Algebra)

$$\left[\begin{array}{cccc|c} 1 & 2 & 3 & 4 & 5 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 2 \end{array}\right]$$

Determine if this matrix is in **Reduced Row Echelon Form**. If not, indicate the reason and use **Gaussian Elimination** to find its **Reduced Row Echelon Form**. Indicate whether the linear system has **infinitely many solutions, exactly one solution, or no solutions**.

An Implementation



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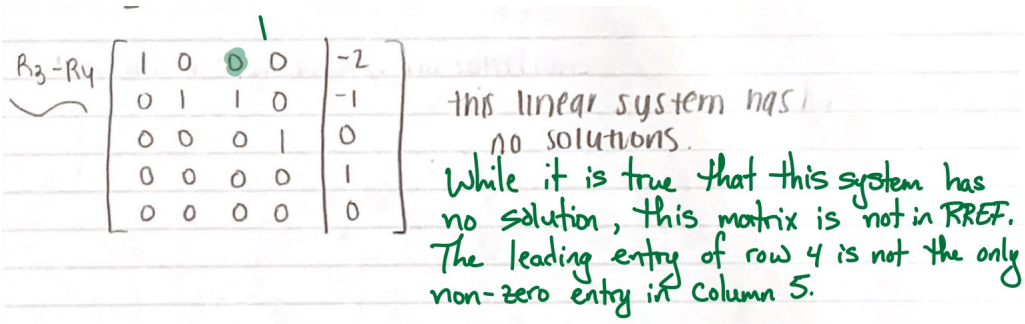

The student received a **P** on this assessment.

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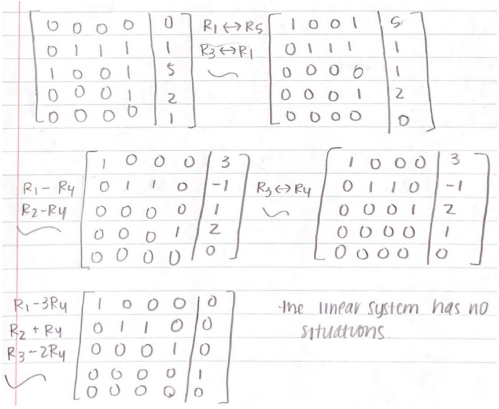

- This is the same student's second attempt on the first reassessment two weeks later.

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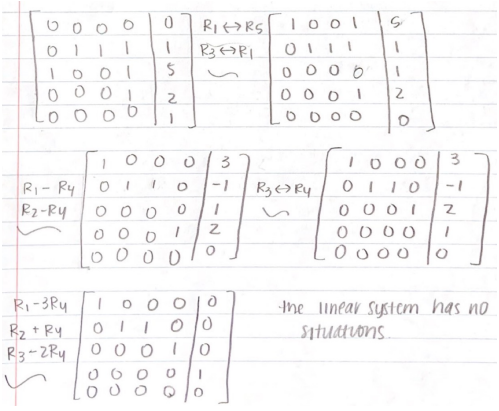

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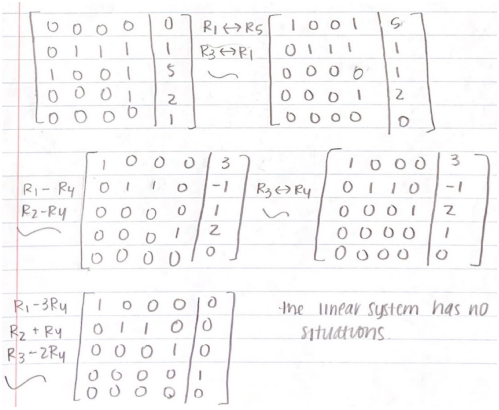

- This is the same student's second attempt on the first reassessment two weeks later.
- The student fixed the problem and earned an **M** for the standard.
- The student never made the same mistake again.

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Example: Linear Algebra

Grade	Number of Standards Mastered
A	17 - 18
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Grade	Number of Standards Mastered
A	17 - 18 (94% - 100%)
B	15 - 16 (83% - 88%)
C	13 - 14 (72% - 77%)
D	11 - 12 (61% - 66%)
F	0 - 10 (0% - 55%)

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Example: Calculus III

# Standards Mastered	MyMathLab Average < 60%	60% - 69%	70% - 79%	80% - 89%	90% - 100%
27-30	B	B	B	B	A
24-26	C	C	C	B	B
21-23	D	D	C	C	C
18-20	F	D	D	D	D
< 18	F	F	F	F	F

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- This is a variant on **Mastery Based Testing**, developed by George McNulty at the University of South Carolina.

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- Students are incentivized to reflect on and correct their mistakes.
  - Students learn the material at a deeper level.

Benefits to the Instructor

Quote

The chair of the department of a Big Ten university once observed, probably after a bad day, that it was possible for a student to graduate with a mathematics major without ever having solved a single problem correctly. Partial credit can go a long way. — Underwood Dudley, *What Is Mathematics For?*

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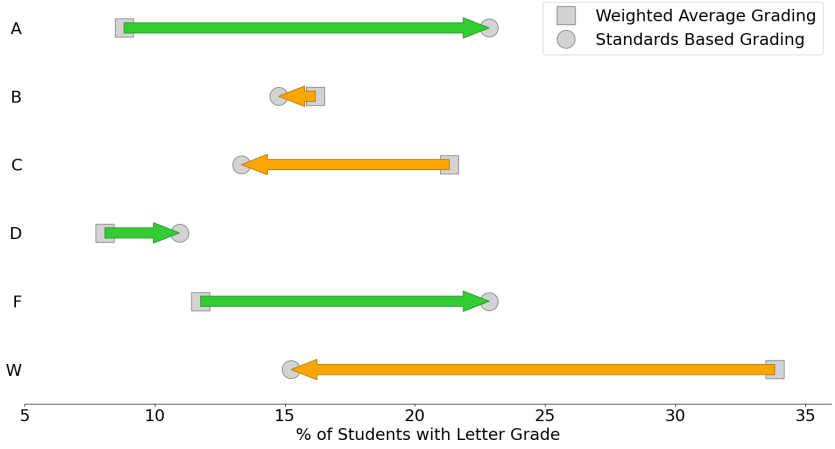
  - Students **must** learn how to solve the problems correctly.
- Hold students to a higher standard without worrying about their GPA.

College Algebra (2021-2022)



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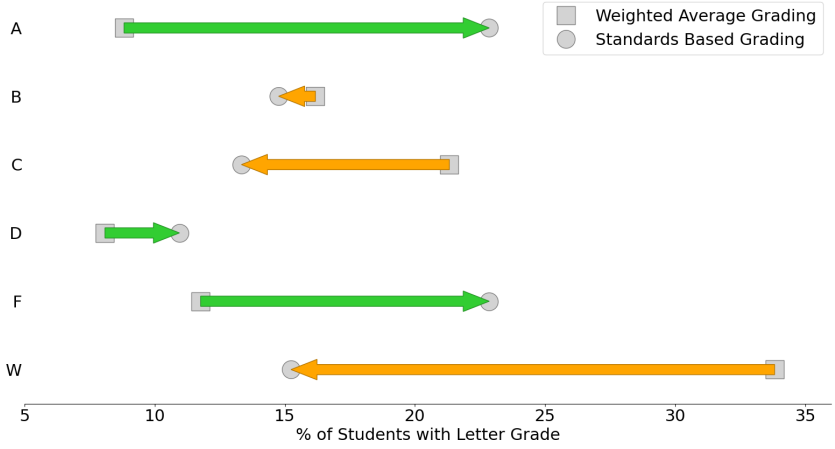

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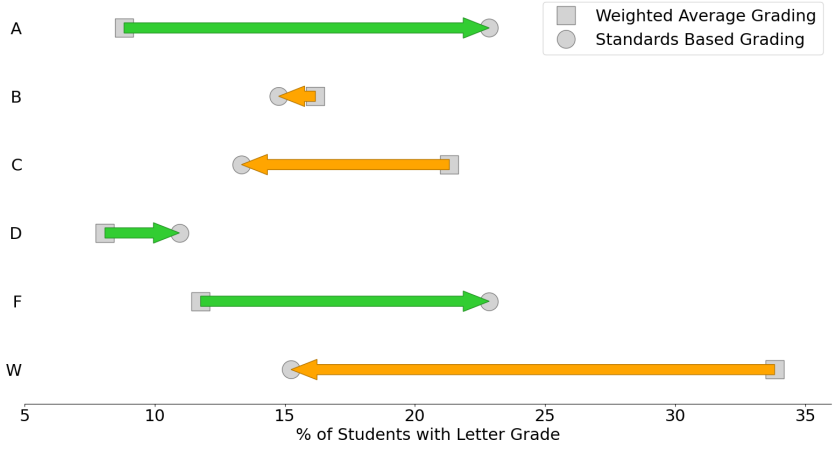
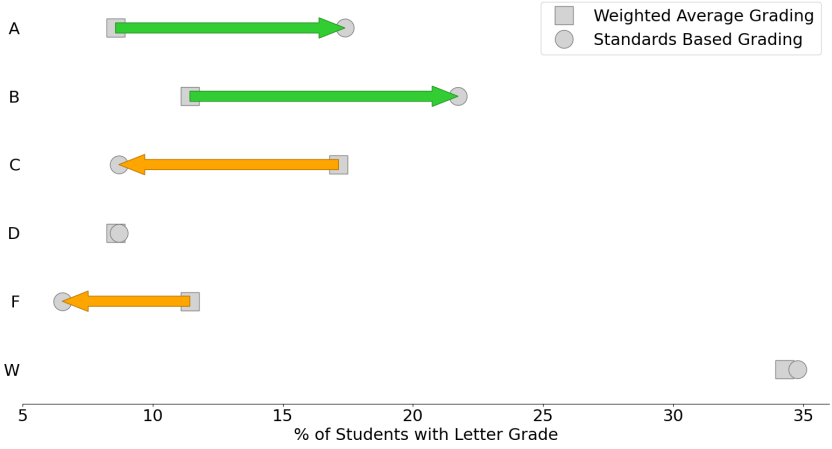


- 51% of students in SBG courses passed.
- 46.3% of students in WAG courses passed.

Performance in Next Math Course



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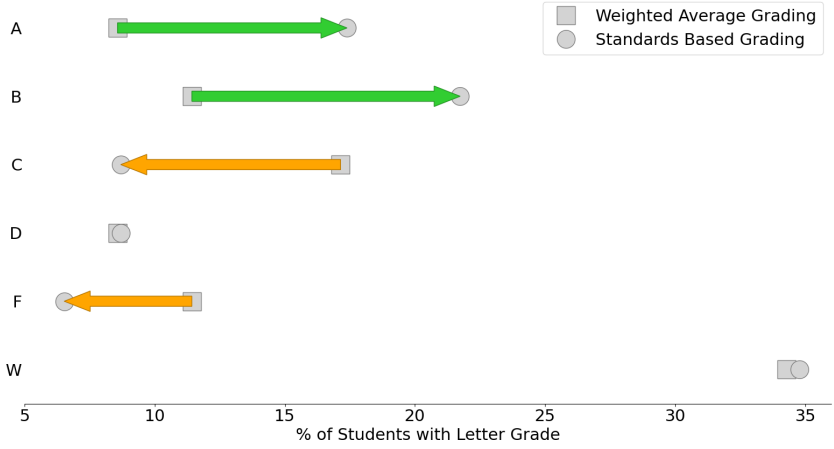

- 49.7% of students in SBG courses passed their next math course.

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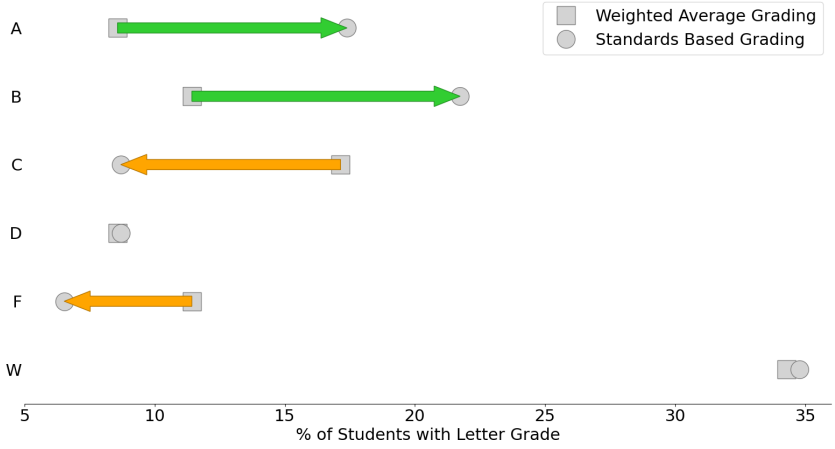

- 49.7% of students in SBG courses passed their next math course.
- 42.1% of students in WAG courses passed their next math course.

Anecdotal Data

- "ALL MATH COURSES NEED TO USE MASTERY BASED GRADING. ABSOLUTELY AMAZING STRATEGY. SIGNIFICANTLY REDUCES STRESS ON STUDENTS AND FACILITATES STRONG DESIRE TO ACTUALLY LEARN CONTENT. PLEASE SHOW THIS TO YOUR DEPARTMENT HEAD AS THIS STRATEGY IS HANDS DOWN THE BEST I HAVE EVER SEEN." —College Algebra Student, Louisiana Tech University
- "I love the mastery system. I wish more classes were like that. It took some pressure off of me to not get all of them right if I didn't have time to study as much or did not understand a topic as much as I thought I did. I also like that your grade can only go up. Once you make an M, you can't lose it." — Calculus III Student, University of Louisiana at Monroe
- "This course was difficult as the concepts were hard & in class we derived everything but you had to figure out on the HW how to apply what we had derived in class. The professor's grading style, however, was unique and contributed to the low level of stress in the class as it provides students w/multiple opportunities to show what they have learned." — Calculus II Student, Lafayette College.

Resources

- Sample Materials
- Community Resources
- Meetings and Workshops
- Scholarly Articles
- `https://ulm.edu/~farman/sbg-resources`

Thank you!