ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Paper ID #40783

Promoting Equity: A Process of Adopting Outcomes-Based Grading in Your Course.

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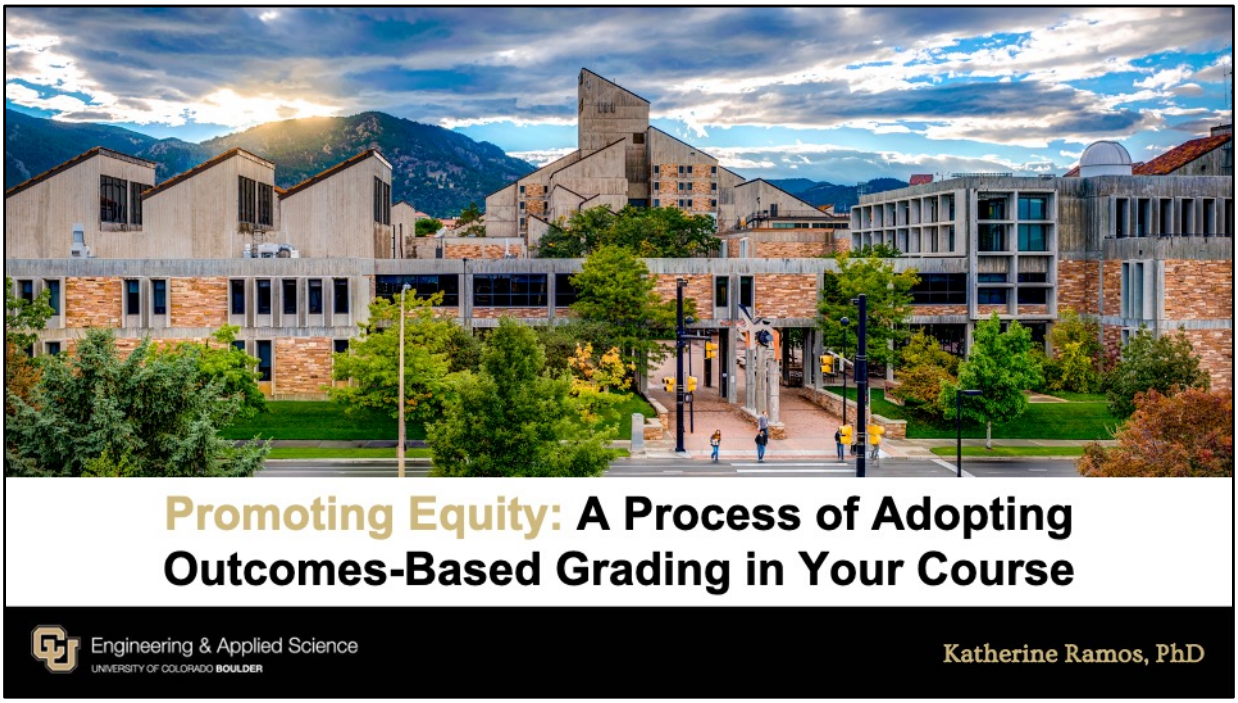
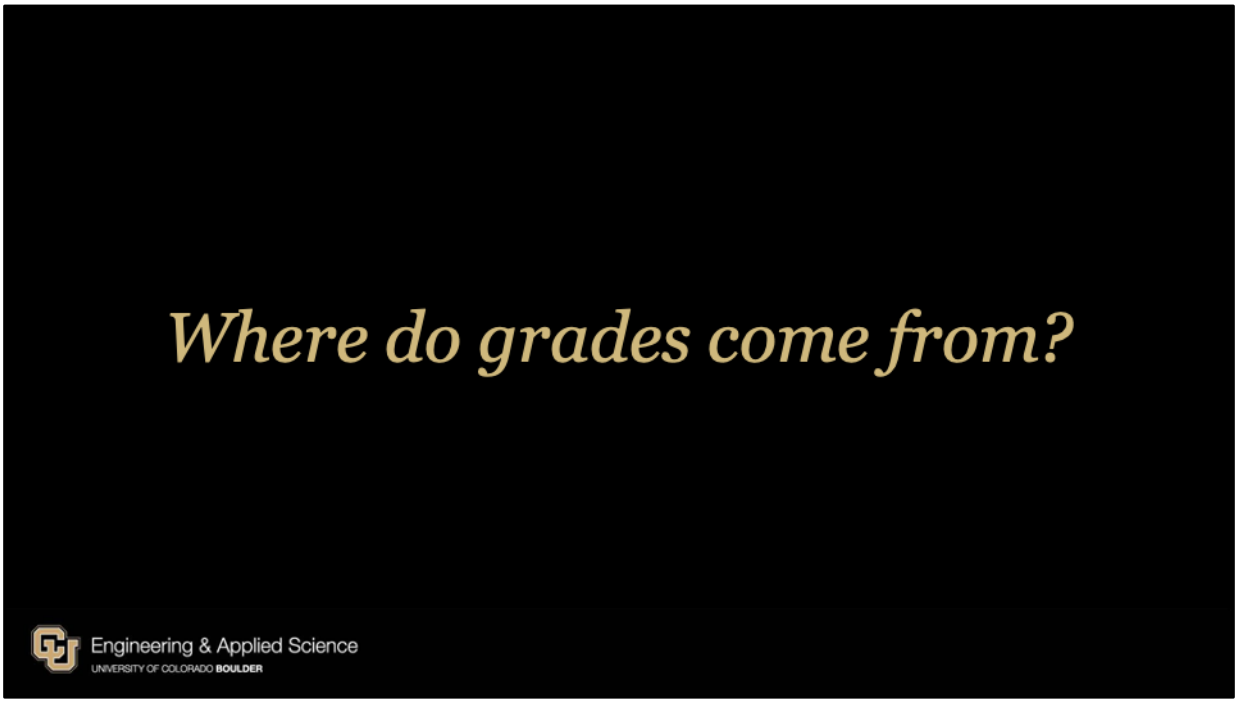
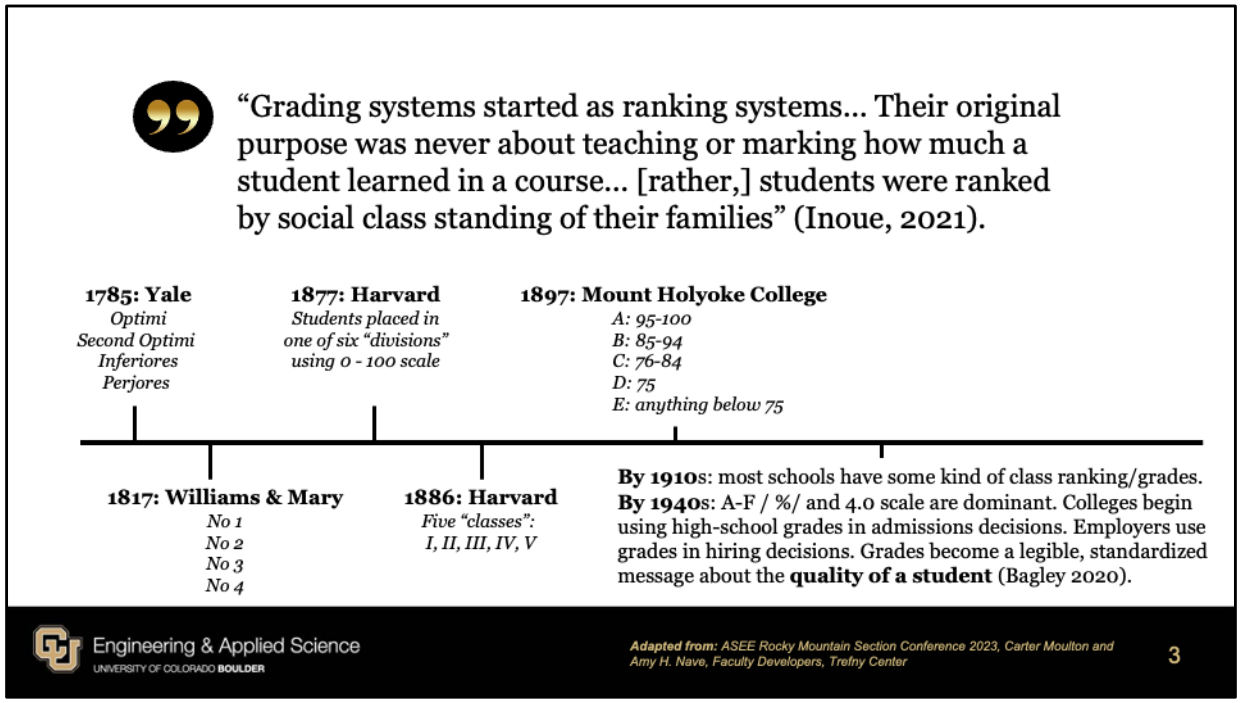


Introduction slide.

Clarify the abstract was submitted however a change wanted to be made to indicate this is not “the” way to adopt but a process that was taken to adopt outcomes-based grading in my course.



Slide to get a get a conversation going.



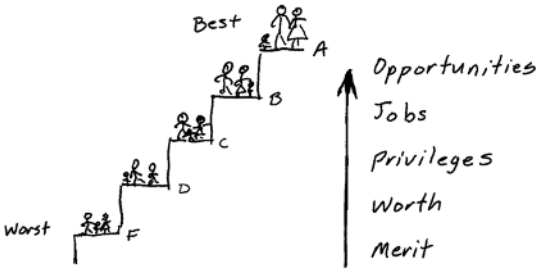
Let's take a look at the history of where grades come from. The data presented in these slides is adapted from a wonderful workshop I participated in over the summer at the ASEE RMS conference in workshop called, A Beginner's Guide to Ungrading & Alternative Assessment.

For the first several hundred years at Harvard, students were categorized according to their families' social class standings. The technologies for ranking and grading students, while not resembling today's systems, were designed to categorize groups based on the social worth or standing of their families.

The first known instance of grading in a way that is similar to what we do today dates back to 1785. The president of Yale, Ezra Stiles, created a four category scale that is similar to the A-F grading scale that most schools use today. Ranging from best, second best, lower..

We then see a variation of this type of ranking system until the introduction of the A–E (now F) scale that tied a letter grade to a numerical and percentage scale.

"Perhaps the most dangerous bias in grading is its inherent ranking of people and what that ranking suggests not just about what students have learned in classrooms but their very worth as people in society" (Inoue 2021).



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Adapted from: ASEE Rocky Mountain Section Conference 2023, Carter Moulton and Amy H. Nave, Faculty Developers, Trefny Center

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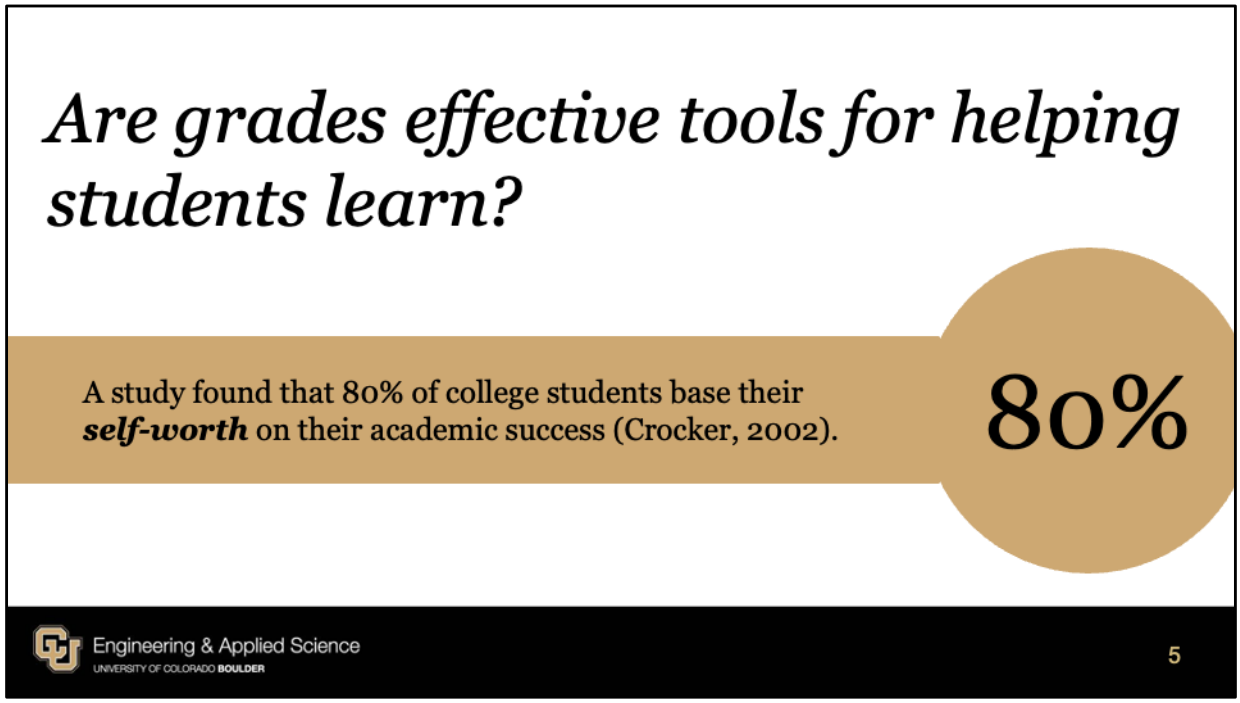
The rationale behind grading in educational institutions may appear evident, yet it prompts us to consider the true insights these grades provide.
How effectively do they convey the extent of our students' learning in our courses?
To what degree are they descriptive, and how do they assist students in comprehending their strengths and weaknesses in the subject area?
If we struggle to find satisfactory answers to these questions, why do we continue to depend on grades as the primary or exclusive method of evaluating students?

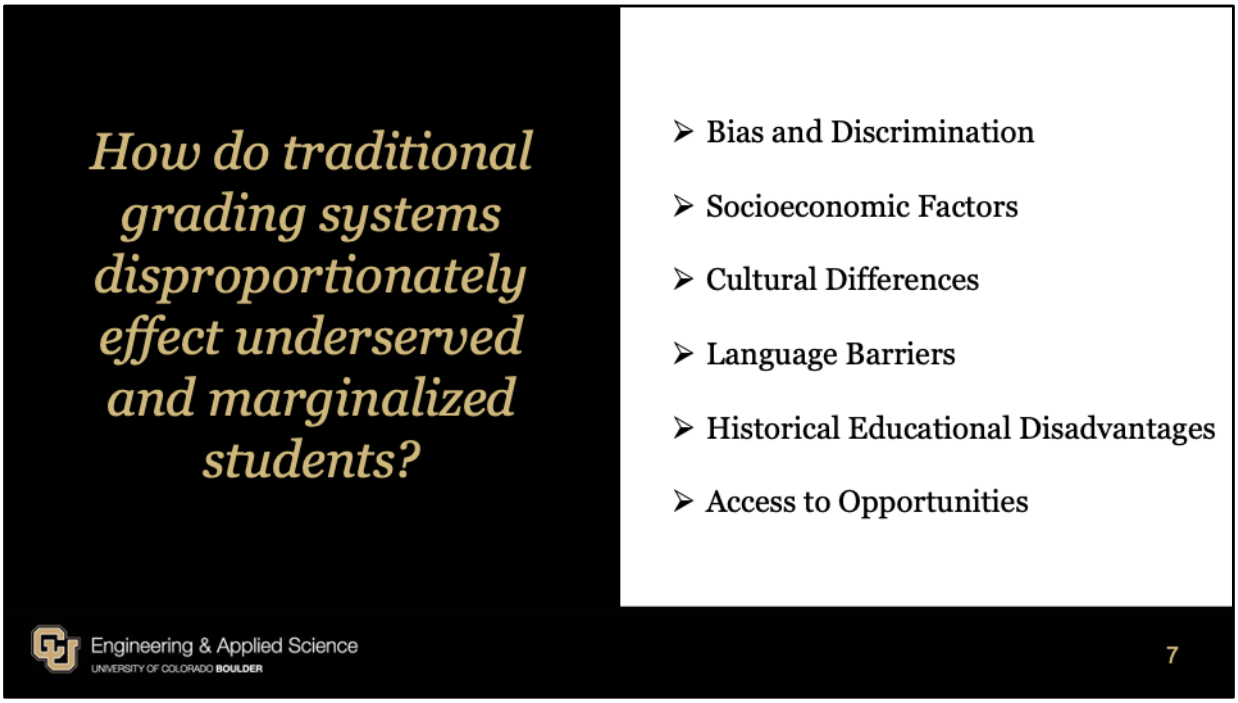


Are grades really effective tools for helping students learn? Can you think of ways these tools may or may not be beneficial to your students? Can you think of ways that they may be harming your students rather than helping them?

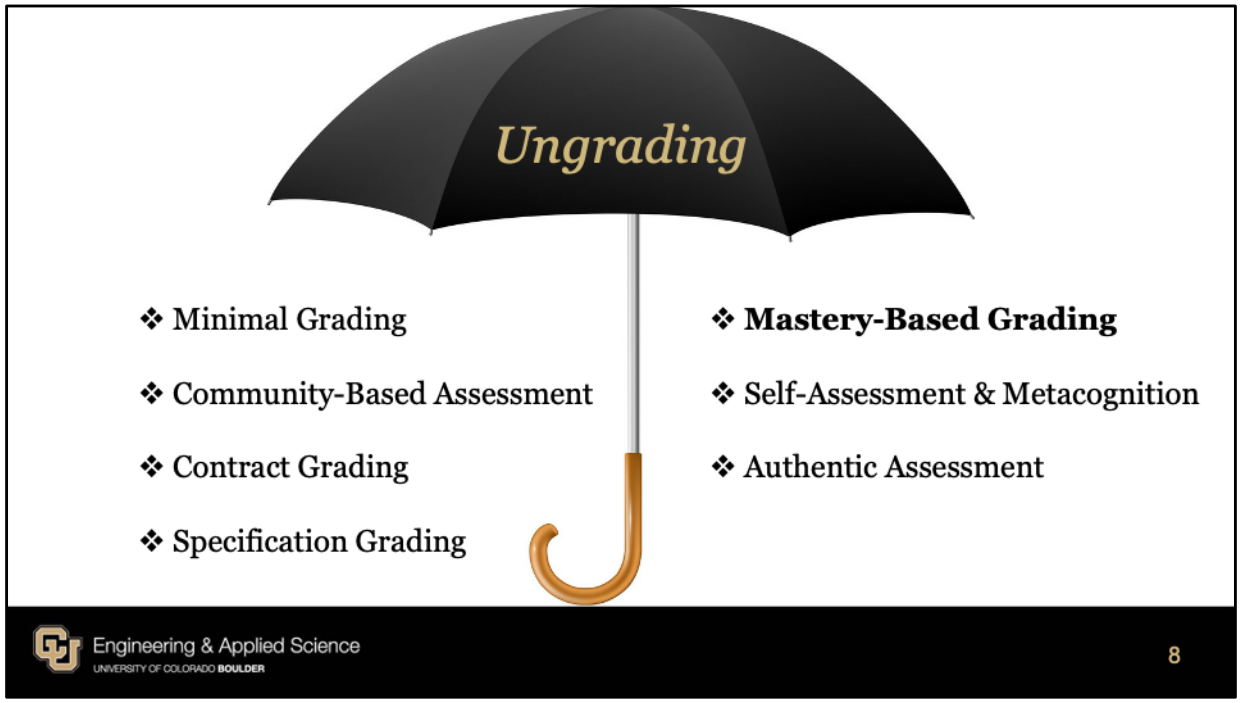
Are grades effective tools for helping students learn?

- Grades are **not good feedback** (Schinske & Tanner 2014; Butler & Nisan 1986).
- Grades flatten the nuances of student learning (Stommel 2020).
- Grades **stifle intrinsic motivation** (Butler, 1988; Crooks, 1988; Pulfrey et al., 2011).
- Grades are **biased and inconsistent** (Malouff 2008; Moss-Racusin et al. 2012; Gillis 2019).
- Grades **close down conversation** and dialogue (Clarke & Talbert 2020).
- Grades **punish failure** instead of reward growth (Pulfrey et al. 2011; Feldman 2020).
- Grades **reinforce teacher/student hierarchies** (Inoue 2004).
- Grades encourage **competition over collaboration** (Howitz, Mcknelly & Link 2021).
- Grades **encourage conformity** over risk-taking (Kohn 2006).
- Grades incentivize getting good grades (cheating, shortcuts) (Kohn 2006; Schultz-Bergin 2020).

What does the research say about this? Let's us review…



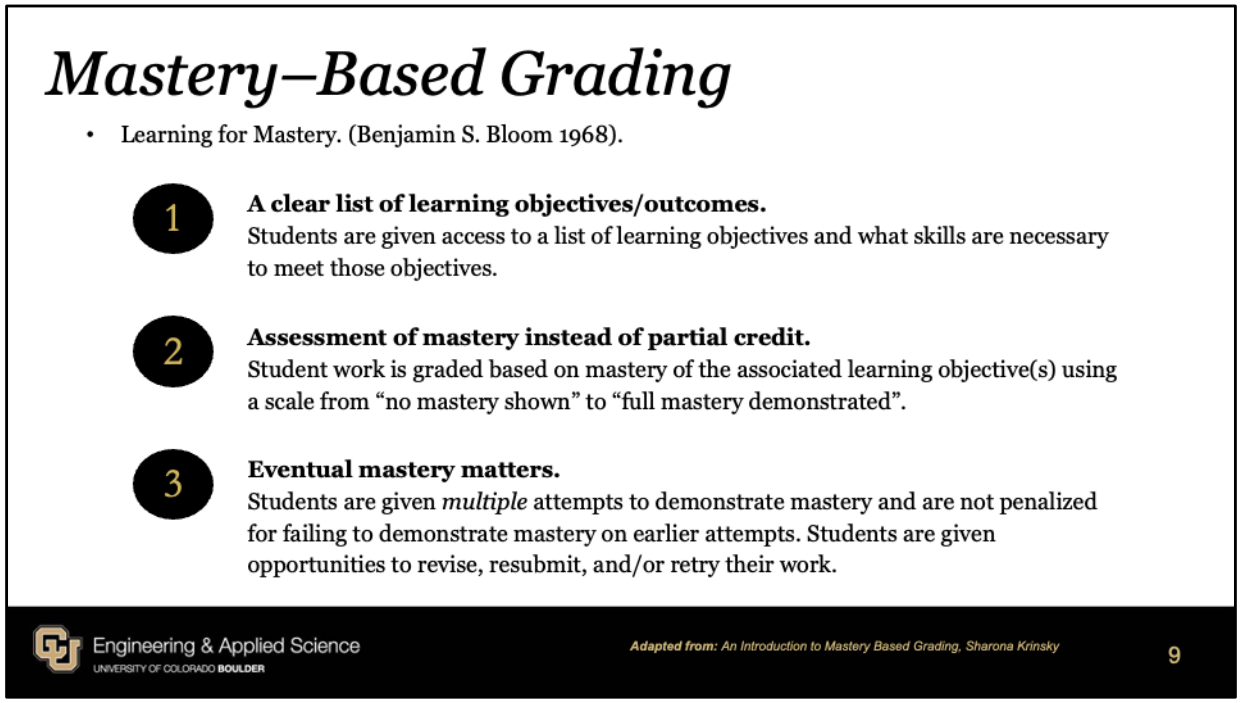
There are many that traditional grading system can be disproportionately impacting our students from traditionally underserved and marginalized backgrounds. Some of the ways include:
Bias / Discrimination – everyone has biases, that can be unconscious or implicit, these have shown to impact students from certain racial/ethnic backgrounds who may receive a lower grade due to biased perceptions and stereotypes help by teachers.
Socioeconomic – access to resources, how might students from low-income backgrounds face challenges in meeting the same expectation as their more privileged peers ?
Cultural Difference / Language Barriers – each can impact how a student is perceived to have learned the material
Historical Edu. Disadvantages – student from historically underserved communities may face disparities that are a result from inadequate school resources, limited access to quality education, and systemic discrimination
Access to Opportunities - Results from traditional grading can then lead to high impact on opportunities that depend on these grades – such as scholarships, internships that further exacerbates educational disparities and can lead to high stress and anxiety



How is ungrading defined?
Ungrading: An effort to decenter the focus on traditional grades and instead put learning at the center of higher education. (Blum 2017, 2020)

Ungrading is a broad term for the many ways we can assess our students in a way that promotes growth and learning.

Minimal Grading - What would it look like to grade less and more simply?
Community-based Assessment – How can we promote the social, collaborative aspects of learning?
Contract Grading - What does success in your class look like for each individual student?
Mastery-Based Grading - How can we prioritize evidence of mastery (over averages/partial credit)?
Specifications Grading - How can we center student growth, choice, and eventual mastery?
Authentic Assessment - How can we mirror the kinds of evaluation/feedback we experience in the workplace or public life?



Since the early introduction of Mastery Learning by Bloom in 1986, there has been a compelling argument to prioritize individualized instruction, feedback, and students mastering content before progressing.
What is Mastery-Based Grading at a glance?
Mastery-based grading is an approach to grading that involved three key features (as presented in slide).

Ungrading Example – Statics

GEEN2851/MCEN2023/CVEN2121 Statics for Engineers Summer 2023

SYLLABUS – Statics for Engineers

Instructor:	Katherine Ramos, Ph.D. Office: DLC 178	Integrated Design Engineering katherine.ramos@colorado.edu
Meeting Times:	Lectures:	M–F 9:20 -10:55 AM ITLL 150
Office Hours:	M–Th 11:00 - 11:30 AM	Immediately After Class

Course Objectives: After this course, you will be able to:

Design a static system to support a load given specific constraints.
Evaluate forces in static structures and critique design decisions.
Predict forces in static systems and potential problem areas.
Apply engineering problem analysis techniques to solve a range of problems. These techniques include drawing free-body diagrams and problem layout.

I'd like to walk us through an example of my own journey in adopting objectives-based grading in my statics course, to show how this could be implemented.

Ungrading/Grading Example – Statics

Grading: The course grade will be based on a combination of group work and individual accomplishment:

Individual work: (85%)

- Homework (15%)
- Class Participation, Attendance, Professionalism (10%)
- Assessments* (60%)

Group work: (15%)

- Mini Projects/Workshops
- Design Project
- Report
- Peer Performance Review

*Assessment will be graded using Outcomes-Based Grading.

Evaluation Score	Meaning
4	EXCEEDS EXPECTATIONS You have demonstrated complete mastery of this element by completing assessments with no errors. Your work is exemplary and complete. Translates to a grade of A
3	MEETS EXPECTATIONS You have demonstrated proficiency in this element. Your work indicates an understanding of the skill or concept but contains minor errors (incorrect or missing units, work not shown, transcription errors). Translates to a grade of B
2	DEVELOPING You have demonstrated adequate progress in this element. Your work demonstrates a basic understanding of the element, but some questions remain. You may do well on simply stated problems but make mistakes on more challenging ones. Translates to a grade of C
1	BEGINNING You have demonstrated insufficient mastery in this element. Your work demonstrates that you have some gaps in your understanding, and success is erratic. This indicates that more practice is needed. Return to the lessons that support this element, or visit with me or the TA for additional problems to try. Translates to a grade of D
0	NO EVIDENCE You have demonstrated insufficient mastery of this element. Your work demonstrates little to no understanding of the concept or skill and contains foundational errors. This indicates the need for supplemental instruction with me, the TA, or a tutor. Unsubmitted work so cannot properly evaluate content mastery. Translates to a grade of F

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It can be overwhelming to think about changing your entire course, so start where you can. In my course, I choose to modify the largest category of course components that I felt would make the most impact – EXAMS. Note that I have moved away from using the words exams in my course to using Assessment. An entire page is dedicated to explaining Outcomes-based grading in my syllabus to give students a clear understanding of how this potentially new concepts works.

How should we interpret the terms "mastery," "proficiency," and "adequate progress"? One perspective is as follows:

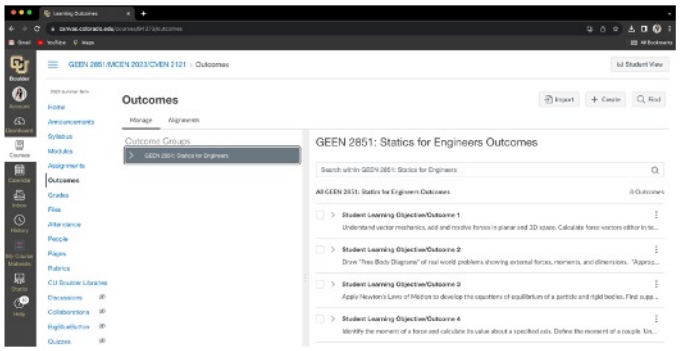
- Beginning: Recognizes pertinent information from the problem statement.
- Adequate progress: Effectively establishes the problem for analysis.
- Proficiency: Applies a correct or partially correct approach but may overlook key elements, such as unit conversions or incomplete work.
- Mastery: Successfully applies foundational and recently acquired knowledge to the problem, producing a correct and comprehensive analysis without errors.

Defining your Course Objectives/Outcomes

Assessment 1

Q1. Three dimensional force systems. Accesses ☐ Resolving forces into their respective components ☐ Units ☐ Free body diagrams ☐ Appropriately using Equations of Equilibrium	Learning Objectives/Outcomes: **SLO1.** Understand vector mechanics, add and resolve forces in planar and 3D space. Calculate force vectors either in terms of Cartesian components or magnitude/direction. *Appropriate use of units **SLO2.** Draw "Free Body Diagrams" of real world problems showing external forces, moments, and dimensions. **SLO3.** Apply Newton's Laws of Motion to develop the equations of equilibrium of a particle and rigid bodies. Find support reactions.
Q2. Moment of a force about a specified axis Accesses ☐ Correctly applying either vector analysis and scalar analysis ☐ Units	**SLO1.** Understand vector mechanics, add and resolve forces in planar and 3D space. Calculate force vectors either in terms of Cartesian components or magnitude/direction. **SLO4.** Understand force system resultants concepts of moment and couple, and reduce distributed loading to a resultant force having a specified location. *Appropriate use of units

Learning Management System – Canvas



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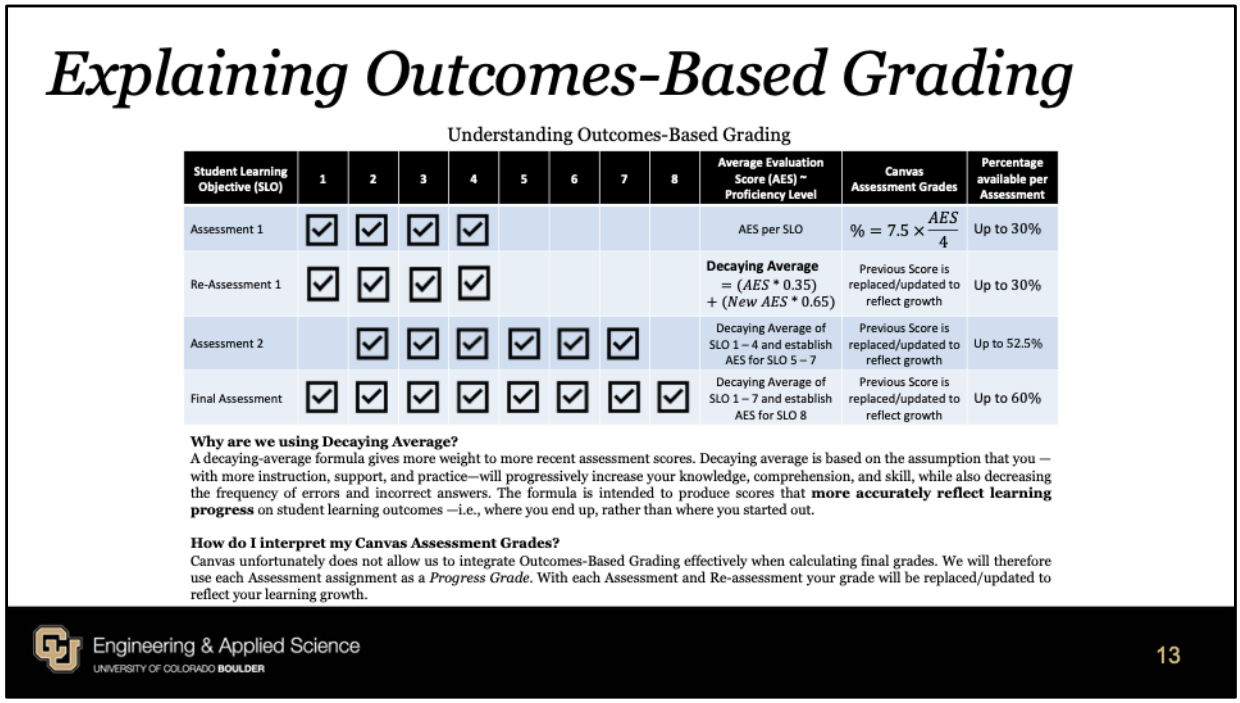
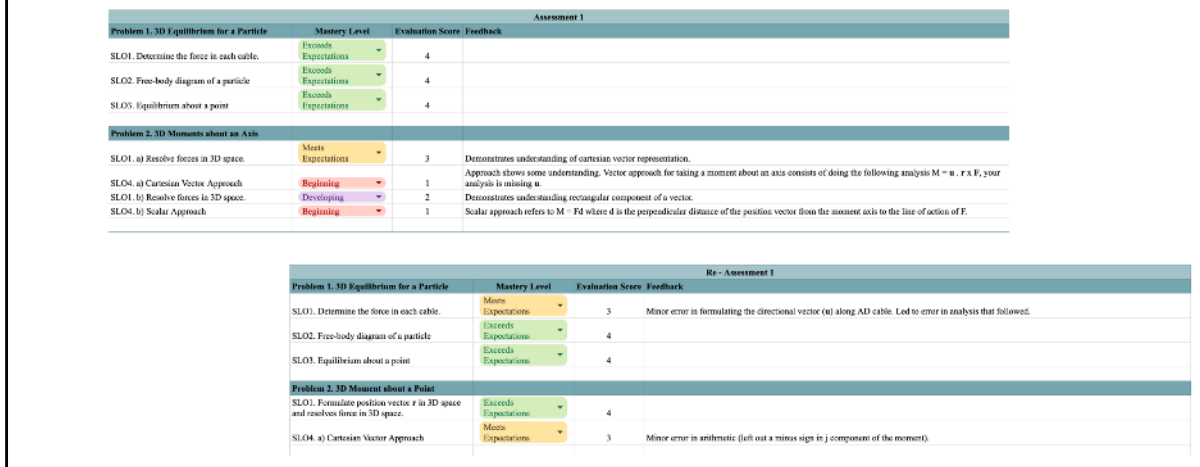
A good place to start is by defining your course objectives/outcomes. This was accomplished by taking each previous exam (now termed assessments) and identifying the objective of each question. From here, these objectives were generalized to account of various concepts that were meant to be learned.
At CU Boulder we use Canvas as our learning management system. Luckily for me Canvas has a way to document/track course outcomes. This does require a few setting adjustments and it's important to note that grading can be somewhat difficult to incorporate into the final grade.



As this concept may be new to many of your students, it's important to be as clear as you can up front. I created the following graphic and posted this to Canvas and welcomed students in class to ask as many questions about the method as they could think of to ensure everyone was comfortable with this concept.

Assessment Feedback



Assessment 1			
Problem 1. 3D Equilibrium for a Particle	**Mastery Level**	**Evaluation Score**	**Feedback**
SLO1. Determine the force in each cable.	Exceeds Expectations	4	
SLO2. Free-body diagram of a particle	Exceeds Expectations	4	
SLO3. Equilibrium about a point	Exceeds Expectations	4	
Problem 2. 3D Moments about an Axis			
SLO1. a) Resolve forces in 3D space.	Meets Expectations	3	Demonstrates understanding of cartesian vector representation.
SLO4. a) Cartesian Vector Approach	Beginning	1	Approach shows some understanding. Vector approach for taking a moment about an axis consists of doing the following analysis M = **u** . **r** x **F**, your analysis is missing **u**.
SLO1. b) Resolve forces in 3D space.	Developing	2	Demonstrates understanding rectangular component of a vector.
SLO4. b) Scalar Approach	Beginning	1	Scalar approach refers to M = Fd where d is the perpendicular distance of the position vector from the moment axis to the line of action of F.

Re - Assessment 1			
Problem 1. 3D Equilibrium for a Particle	**Mastery Level**	**Evaluation Score**	**Feedback**
SLO1. Determine the force in each cable.	Meets Expectations	3	Minor error in formulating the directional vector (u) along AD cable. Led to error in analysis that followed.
SLO2. Free-body diagram of a particle	Exceeds Expectations	4	
SLO3. Equilibrium about a point	Exceeds Expectations	4	
Problem 2. 3D Moment about a Point			
SLO1. Formulate position vector r in 3D space and resolves force in 3D space.	Exceeds Expectations	4	
SLO4. a) Cartesian Vector Approach	Meets Expectations	3	Minor error in arithmetic (left out a minus sign in j component of the moment).

Feedback is key in this approach. Unfortunately, this proved to be difficult within Canvas and other grading systems like Gradescope. I opted to use a spreadsheet* that I would then export and attach to the assignment on Canvas. This way, I was able to provide detailed feedback on each learning objective and break down each concept into smaller parts to help students identify gaps in their knowledge.
The example above shows a student who took the first assessment and the first re-assessment opportunity. As shown, there is major improvement. *Intend to show the spreadsheet used to grade assessments.

Assessment Feedback

Assessment 1

Problem 1. 3D Equilibrium for a Particle	Mastery Level	Evaluation Score	Feedback
SLO1. Determine the force in each cable.	Exceeds Expectations	4	
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SLO3. Equilibrium about a point	Exceeds Expectations	4	
Problem 2. 3D Moments about an Axis			
SLO1. a) Resolve forces in 3D space.	Meets Expectations	3	Demonstrates understanding of cartesian vector representation.
SLO4. a) Cartesian Vector Approach	Beginning	1	Approach shows some understanding. Vector approach for taking a moment about an axis consists of doing the following analysis M = **u** . r x F, your analysis is missing **u**.
SLO1. b) Resolve forces in 3D space.	Developing	2	Demonstrates understanding rectangular component of a vector.
SLO4. b) Scalar Approach	Beginning	1	Scalar approach refers to M = Fd where d is the perpendicular distance of the position vector from the moment axis to the line of action of F.

Assessment 1 – *Progress Grade*

Evaluation Scores for Mastery	Avg. Eval. Score	Score Translation
Student Learning Objective 1	3.00	5.63
Student Learning Objective 2	3.14	5.89
Student Learning Objective 3	3.00	5.63
Student Learning Objective 4	2.43	4.55
	Grand Total	21.70
	Out of :	**30**

Re - Assessment 1

Problem 1. 3D Equilibrium for a Particle	Mastery Level	Evaluation Score	Feedback
SLO1. Determine the force in each cable.	Meets Expectations	3	Minor error in formulating the directional vector (**u**) along AD cable. Led to error in analysis that followed.
SLO2. Free-body diagram of a particle	Exceeds Expectations	4	
SLO3. Equilibrium about a point	Exceeds Expectations	4	
Problem 2. 3D Moment about a Point			
SLO1. Formulate position vector **r** in 3D space and resolves force in 3D space.	Exceeds Expectations	4	
SLO4. a) Cartesian Vector Approach	Meets Expectations	3	Minor error in arithmetic (left out a minus sign in j component of the moment).

Decaying Average – 65/35

Evaluation Scores for Mastery	Avg. Eval. Score	Decaying Avg	Score Translation
Student Learning Objective 1	3.67	3.43	6.44
Student Learning Objective 2	4.00	3.70	6.94
Student Learning Objective 3	4.00	3.65	6.84
Student Learning Objective 4	3.67	3.23	6.06
		Updated Grand Total	26.28
		Out of :	**30**

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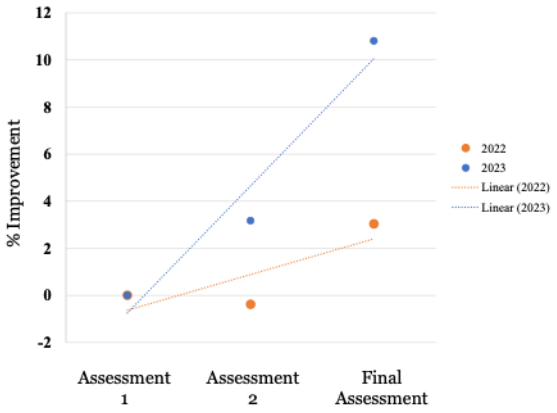
Feedback is key in this approach. Unfortunately, this proved to be difficult within Canvas and other grading systems like Gradescope. I opted to use a spreadsheet* that I would then export and attach to the assignment on Canvas. This way, I was able to provide detailed feedback on each learning objective and break down each concept into smaller parts to help students identify gaps in their knowledge.
The example above shows a student who took the first assessment and the first re-assessment opportunity. As shown, there is major improvement. *Intend to show the spreadsheet used to grade assessments.

Comparison of Summer 22 – Summer 23



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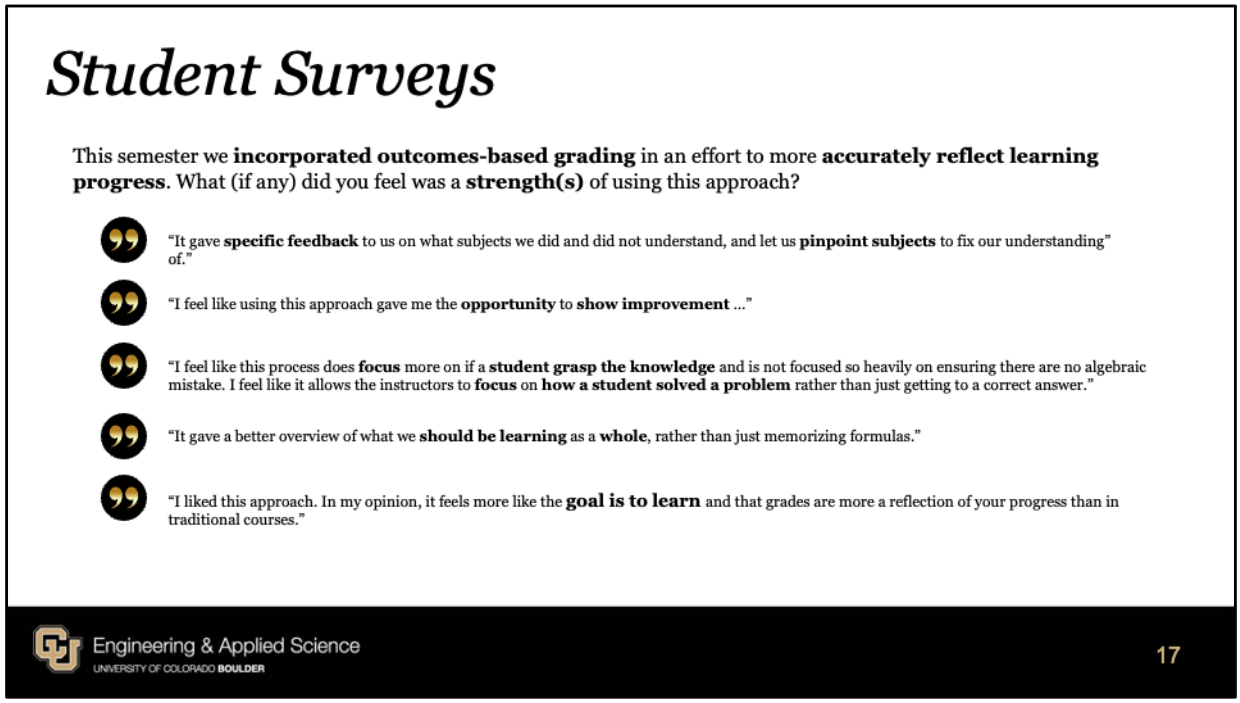
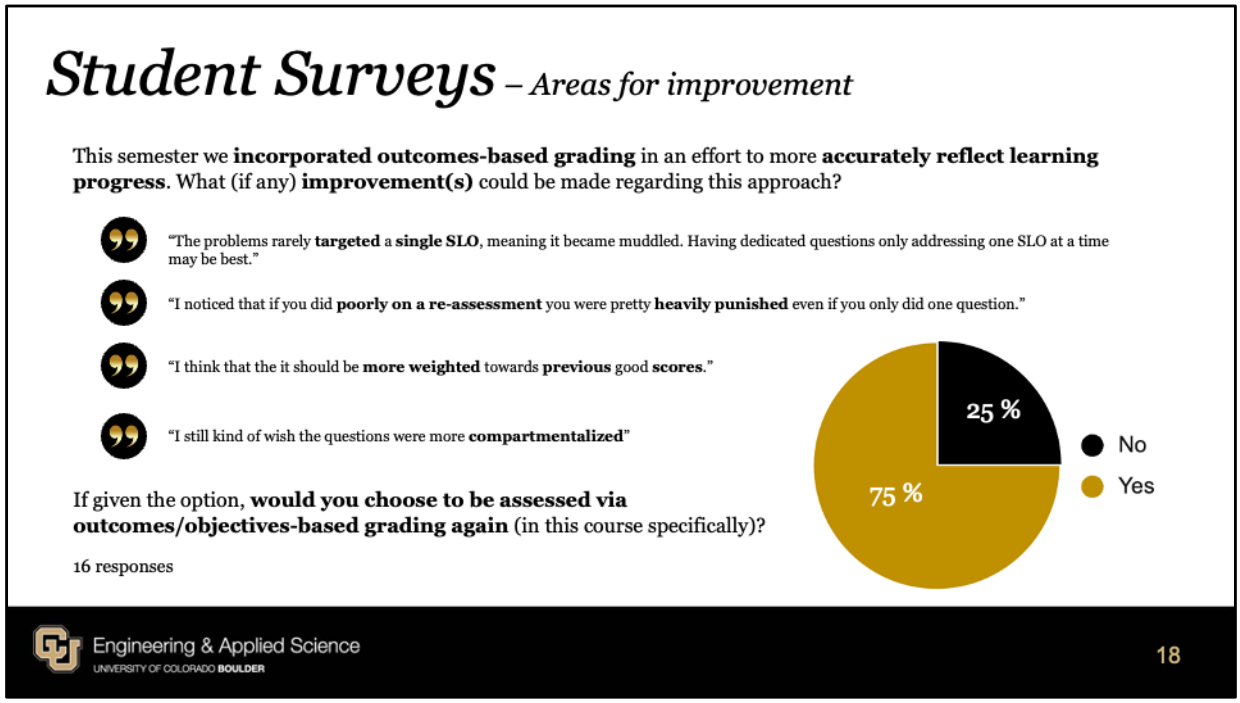
A side-by-side comparison of the grade distribution from the previous summer to this summer is presented.
Important take-away:
Greater improvement in learning objectives from one assessment opportunity to the next in Summer 2023. Note, re-assessment 1 is not included as it was not offered in Summer 2022.
Summer 22 – 13 students
Summer 23 – 19 students

*Looking ahead, it is feasible to undertake a study that compares the performance of this course with the standard course offered in the Fall semester (taught by a different instructor using traditional grading methods). To initiate a research study, our program could commence by submitting a proposal through the Institutional Review Board (IRB). An approach to consider involves implementing the outlined process from this presentation and subsequently comparing the performance of one cohort with the next. Special consideration would be given to key metrics, including Bias, Discrimination, Socioeconomic Factors, Cultural Differences, Language Barriers, Historical Educational Disadvantages, and Access to Opportunities.



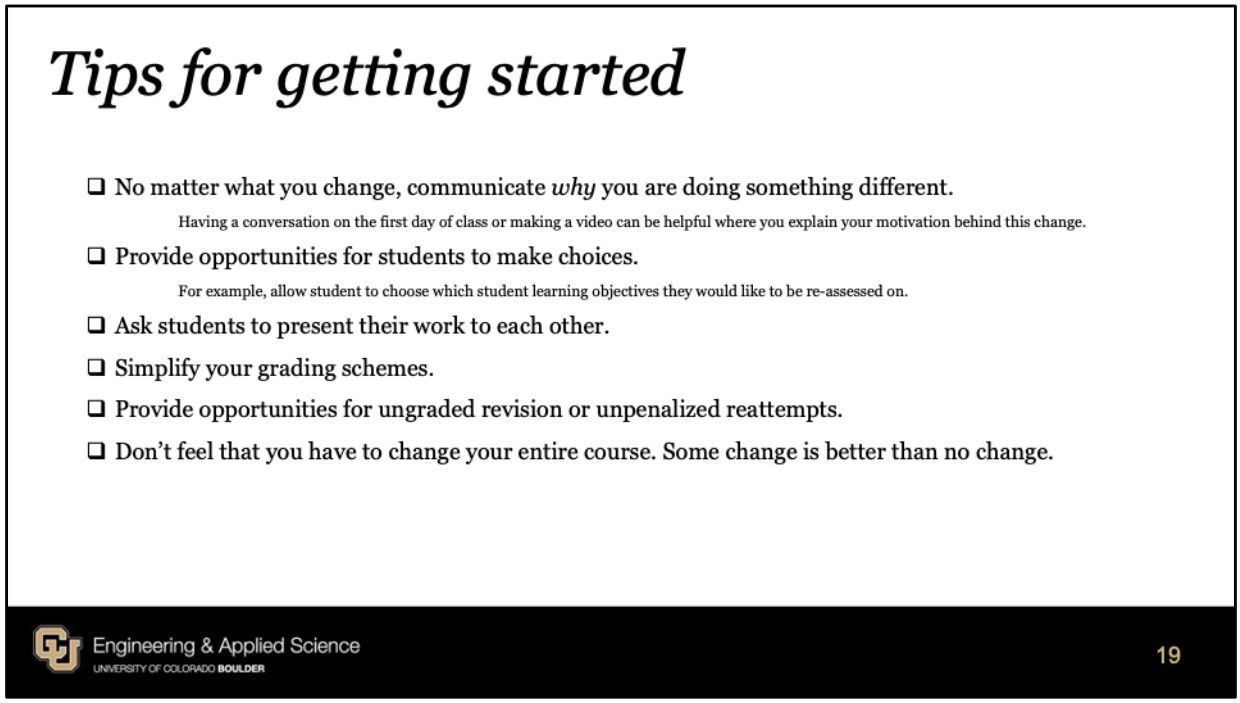
Here are a few excerpts of what my students were saying about this new approach. Let's highlight a few themes here.



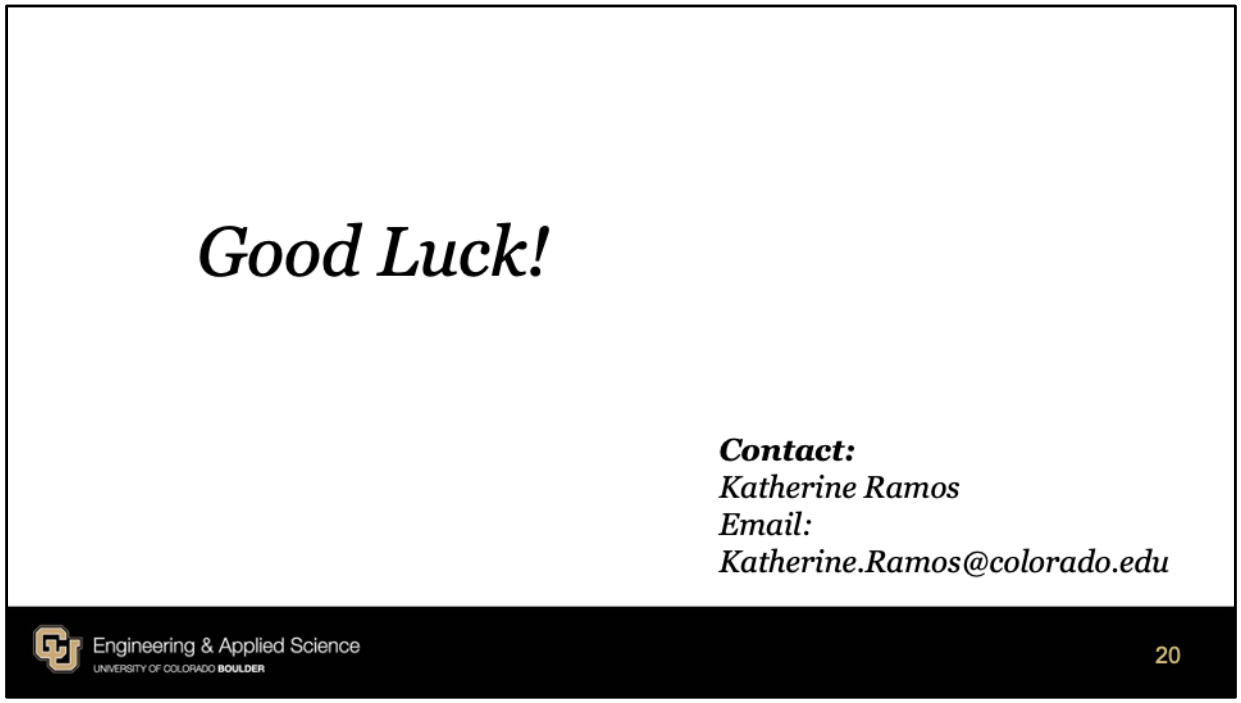
Here are a few excerpts of what my students were saying about this new approach.
Important takeaways:
Since this was the first time I incorporated this into the course, there is most certainly areas for improvement. One highlighted by my students was the need to break out the student learning objectives further (e.g., creating subsets for each – Under SLO4 (Moments), we could break these out to include moments for each of the following 4.1) Identify the moment of a force and 4.2) calculate its value about a specified axis. 4.3) Define the moment of a couple. etc.)

Important to note that some students did mention they would prefer that the decaying average be increased contrary to some of these statements indicating it's a delicate balance on setting that threshold. Common practice is to set this decaying average at 65/35 (which means the most recent score will be weighted as 65% of the grade, while the total of all other scores will be weighted at 35%). Have seen these threshold set anywhere from 60/40 to 80/20.

Example student responses.
"I would put more weight into the reassessments and regrading as that shows signs of development and growth. "
"it seems unfair that improvement in a topic only *partially* replaces the grade of mastery originally scored. It means if I did really bad in a topic at first, studied really hard, then mastered it down the line, I dont get as rewarded for progress since the first bad grade pulls it down."



A few tips that can help get your started. Feel free to reach out to me. I had a lot of help and coaching from different teaching and learning centers at my universities and others! There are even ungrading learning communities that you could reach out to and connect with. The important note here is to communicate with your students as much as you can before, during and after this implementation to ensure everyone feels they are a part of the process.



Feel free to reach out to connect. I'm happy to help if I can.