

What I've Learned from Five Years of Standards-Based Grading

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Alternative Grading

This talk is about what I have learned from converting my differential equations classes to standards-based grading (SBG). SBG is one of many types of grading systems that are often referred to by “alternative grading,” thought of in contrast to “traditional grading.” Traditional grading is problem what most of us have used/grew up with:

- Points are given on each assignment.
- A specific weighting converts the points on each assignment to an overall score.
- Students are assigned final grades based on that overall score.
- In some sense, involves ranking students, and a curve may be applied to get “desired” grade distributions.

Why Traditional?

This “traditional grading” system has stuck around so prevalently once it came about in the late 19th century for a few reasons:

- It is easy to compute, and most systems for handling grades do this very well.
- It is easy to send a summary to another institution if a student is transferring.
- Students can see how they’re doing throughout the semester (whether that’s useful or not is up for debate).

However, that’s kind of where the benefits end.

Why Something Else?

Assume that a course has three exams and a cumulative final, and that is all that determines the final grade. Each exam is scored out of 100 points, and the final is out of 200 points.

Name	Exam 1	Exam 2	Exam 3	Final	Total
Alex	20	50	80	200	350
Sam	70	70	70	140	350
Taylor	80	30	80	160	350

All of the students have a 70% average for the entire semester, so they would all get the same grade in a traditional system. However, there's a lot more going on here with their grades.

Why Something Else?

There's a fair bit of research out there that shows that numerical grades can cause some problems with how students interact with feedback:

“‘Check the grade [laughter], log out [agreement, laughter]’ (P4, FG1)” [5]

As predicted, the comments group scored significantly higher than the others [...] and there was no significant difference between the grades and no-feedback groups. [2]

“...students described how they do not engage with feedback ‘because it’s not as if your mark’s going to increase if you act upon it’ (P18, FG4), and because ‘you’re not going to get any more marks for looking at it’ (P19, FG4).” [5]

However, I want to give another argument for a different approach to grading.

Grading as Incentive Structure

The common mantra is: If you want students to do something. assign points to it. While a bit crude, the truth is that how we grade things should reflect what we want students to learn and how we want them to go through the process of learning.

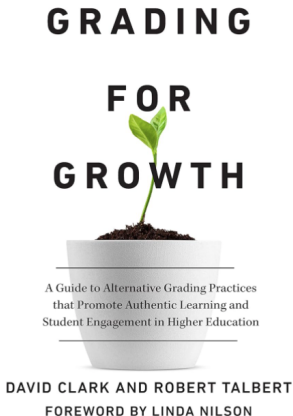
- Want them to come to class? Take attendance and score them on it.
- Want them to do homework? Make it worth something.
- Want them to persevere through failure? ???
- Want them to review their old mistakes and learn from them? ???
- Want them to actually learn the course material? ???

Without a grading structure that supports the last points, it is less obvious to students that they should be doing these things.

My Introduction to SBG

- MAA Project NExT
- General displeasure over the way that final grades felt
- Grading Conference
- Other online resources

A New Resource



A new resource for people interested in this topic (published 2023) is *Grading for Growth* by David Clark and Robert Talbert [3]. They are both math instructors at Grand Valley State University, and continue to expand on these ideas on their blog [4].

This is a great resource for the history of grading as well as a workbook for designing your course with these alternative grading methods.

Basics of SBG

- Course is broken down into discrete learning outcomes.
- Students are assessed on each of these in turn, until they can show complete understanding of that objective.
- Reassessments are allowed for objectives that were missed earlier in the semester.
- Letter grade is determined by number of objectives shown to be understood by the end of the semester.

Connections to Incentive Structure

- Resubmissions to correct small mistakes
- Explicit opportunities to revisit old objectives later
- Later attempts can erase earlier mistakes
- Need to show full understanding in order to get credit

Learning Outcomes

One of the easiest ways to help students understand what they need to know in a course is by telling them through explicit learning outcomes.

- Should be a measurable outcome.
- Should be expressed in language that a student in this course can understand.
- Needs to be something that you are willing (and plan to) assess in this course.
- Scope is hard here.

Learning Outcomes Activity

I will show you a few of my learning objectives from differential equations in a second. At this point, I want all of you to think about what some properly written learning objectives for a common course you teach would be.

- Active language.
- Specific enough to be measurable.
- Broad enough that they can cover the entire course.

Take a few minutes to think about this, then discuss it with the people around you. Provide some suggestions for how to improve or modify the learning objective.

My Learning Outcomes

F1: I can find the general solution to a first order linear ODE and solve initial value problems of this type.

D2a: I can write a first-order differential equation and initial value problem to model the rates of change in a tank problem and interpret the results in terms of the given situation.

D3b: I can model and analyze forced mechanical and electrical vibrations using linear, second-order, constant-coefficient linear differential equations.

Math 244: Differential Equations for Engineers

- Math 244
- Mostly engineering students who need this material for future classes
- Generally sophomores taking it
- For some, this is their last math class, other majors will need one more after that
- Class size around 75-90, one TA to help with grading
- I generally teach two of these each semester

Course Structure

- 25 course objectives
- 11 of these are “CORE” objectives, which all students must get correct to pass the course
- Students need to earn 3 “checkmarks” for each objective. Getting the problem correct on a quiz gives 1, exams give 2.
- Small algebraic mistakes can be corrected and resubmitted.
- Exams are always cumulative, but students can skip problems.
- Three bonus quiz attempts right before last two exams and the final.

Grade Checklist

Core Objectives:

Objective	Mark 1	Mark 2	Mark 3
D1	☐	☐	☐
D2a	☐	☐	☐
F1	☐	☐	☐
F2	☐	☐	☐
N1	☐	☐	☐
S1a	☐	☐	☐
S1b	☐	☐	☐
S1c	☐	☐	☐
L1	☐	☐	☐
L2	☐	☐	☐
L3	☐	☐	☐

Other Course Components:

Objective	Score	Mark
Matlab	65 pts	☐
Matlab	110 pts	☐
Daily	40 pts	☐
Daily	75 pts	☐
Daily	105 pts	☐

Non-Core Objectives:

Objective	Mark 1	Mark 2	Mark 3
D2b	☐	☐	☐
D3a	☐	☐	☐
D3b	☐	☐	☐
F3	☐	☐	☐
F4	☐	☐	☐
N2	☐	☐	☐
S2	☐	☐	☐
L4	☐	☐	☐
Y1a	☐	☐	☐
Y1b	☐	☐	☐
Y1c	☐	☐	☐
Y2 (Q x2)	☒	☐	☐
Y3 (Q x2)	☒	☐	☐
D4 (Q x2)	☒	☐	☐

Computing Letter Grade

- Quizzes give 1 ☒ for an M score.
- Exams give 2 ☒s for an M score.
- Count up the total number of check marks on this page.
- Use the table on the reverse side to determine how this results in a letter grade.

Letter Grades

Final Grade	Num ☒	M on Core Final	Max Curve
A	77	11	1
B+	73	10	2
B	66	9	3
C+	62	8	4
C	55	6	5
D	52	5	6

Developments over the years

- Number of learning outcomes came down from 30 to 25.
- Used to have extra bonus quizzes earned by doing resubmissions or completing a portfolio, those have been removed.
- Token system for opening old assignments for resubmission.
- Using Canvas API to automate some of this.
- Automation of most problem version generation.

Things I Have Learned

- ① Keep it simple
- ② Limit number of opportunities
- ③ Office hours
- ④ Grading and problem versions
- ⑤ Working with TAs
- ⑥ Student Buy-in
- ⑦ Fighting with Canvas

Keep It Simple

It's really important to keep the system simple. Mine is still probably too complicated.

- Don't have too many learning objectives.
- Simplify the conversion from learning objectives to letter grades.
- Remove extra moving parts when possible.
- Be extremely careful when adding things to the course.
- Do all of this, then purge some more.

Number of Opportunities

Just because students get to reattempt objectives does not mean they get an infinite number of reattempts. This should be limited, both for your sake and theirs.

- At least three or four attempts for each objective is enough.
- Final exam as one last attempt at everything works well.
- Provide extra exam-level practice problems instead of more attempts.
- Less attempts means they have to take each one seriously.

Office Hours

I've seen a large shift in office hour attendance and usage with a system like this.

- Students know specifically what to ask questions about.
- They know that a similar problem will show up on a future exam that they will need to get right.
- No partial credit means the stakes are high for actually knowing how the problem works, and they will ask about it.
- “Did you redo the quiz problem?”

Grading and Problem Versions

This kind of system will involve writing and grading a fair number more problems than a “traditional” system. You need to give reattempts and then grade reattempts.

- No partial credit makes the grading go a lot faster.
- Grading resubmissions is (usually) fairly quick.
- Needing to write a lot of problems for each topic is no small task.
- How you choose the learning objectives can go a long way towards making it easier to write problems.
- Automation Scheme: Write a few different types of problems, then randomize the numbers.

Working with TAs

I have a TA for each of my sections, so there's someone else who is also grading for the course. With a system like this, it is very important to keep grading and policies consistent.

- Be very upfront about the system with the TAs and answer any questions early on.
- Develop a grading guide with common mistakes and how that should be taken into account.
- Emphasize policies or deadlines that the TA should communicate.
- Be clear about who is responsible for what. Particularly involving resubmissions.
- They will likely require training and guidance throughout the semester.

Student Buy-In

Student buy-in is hard. I have yet to figure out a good way to get student buy-in early in the semester. It's a work in progress.

- No partial credit is a big blow. Students will react when you say it initially, when they get their first quiz back, and at the first exam.
- I've usually found that it takes up to Exam 2 before they finally realize what the system is trying to do.
- Some students will love it, some will get by, and a small few will despise it. Mainly because it makes them learn.
- Once students get it, interactions are much better.
- Not all grade grubbing goes away, but most of it does.

Fighting with Canvas

Canvas, along with most other LMS, don't really play well with a system like this. You'll have to do more things manually on the grade end.

- Canvas Mastery Gradebook is ok, but you can't upload/automatically fill in from a score. So you'd have to manually click boxes for every student. Do not recommend.
- I have one assignment per problem, and then use Excel to collect the data and pull it all together.
- Need to email students to let them know where they're at, since Canvas won't really tell them.
- Canvas API interactions can help with this (and the API is pretty good), but that's not an entry level thing.

How to get started?

- Think through learning objectives and course alignment, and make this explicit for the students
- Add an extra reattempt to quizzes
- Allow resubmissions on homework/in-class problems.
- Exam Resubmissions, maybe as a replacement homework
- Be explicit about the final exam replacing earlier performances (works well with specific learning outcomes)

Summary

- Important to think about how grades affect the way that students approach your course.
- Standards-Based grading, or the ideas that inspire it, can give a better way to setup grades that better aligns with student learning.
- Even a small change can go a long way towards giving the students the agency and clarity they need to perform better in your course.

Thank you!

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References



[1] Butler, R. (1988). Enhancing and Undermining Intrinsic Motivation: The Effects of Task-Involving and Ego-Involving Evaluation on Interest and Performance. *British Journal of Educational Psychology*, 58(1), 1–14. <https://doi.org/10.1111/j.2044-8279.1988.tb00874.x>.



[2] Butler, R., & Nisan, M. (1986). Effects of no feedback, task-related comments, and grades on intrinsic motivation and performance. *Journal of Educational Psychology*, 78(3), 210–216. <https://doi.org/10.1037/0022-0663.78.3.210>.



[3] Clark, D. and R. Talbert. *Grading for Growth: A Guide to Alternative Grading Practices That Promote Authentic Learning and Student Engagement in Higher Education*. Routledge. 2023. ISBN: 9781642673807.



[4] Clark, D. and R. Talbert. Grading for Growth. Blog. <https://gradingforgrowth.com/>



[5] Winstone, N., Bourne, J., Medland, E., Niculescu, I., & Rees, R. (2021). “Check the grade, log out”: Students’ engagement with feedback in learning management systems. *Assessment & Evaluation in Higher Education*, 46(4), 631–643. <https://doi.org/10.1080/02602938.2020.1787331>.