

Pre-Reading Discussion Questions

To prepare for the reading that follows, write down your responses to the following questions and discuss them with someone around you.

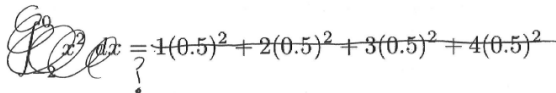
1. What are your experiences with grading? (*Note: You have experiences with grading – it just may be you receiving the grade, not giving the grade...*)

2. Whether or not you've graded previously in your academic career, you've had a couple opportunities during orientation to get a feel for what grading is like.

Based on your experiences, what challenges do you foresee arising while grading?

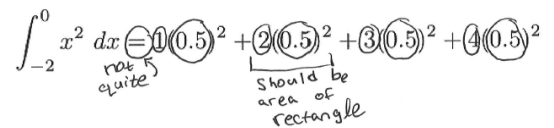
3. The following is an answer to an exam problem from a student that has been graded by two different graders. The exam problem was "Estimate $\int_{-2}^0 x^2 dx$ using left hand sums with $n = 4$ subdivisions." The typed content is the student work; the hand-written marks and comments are from the graders. Compare and contrast the grading. What are some good things you see about the grading? What are some bad things?

Grader 1



The student has written $\int_{-2}^0 x^2 dx = 1(0.5)^2 + 2(0.5)^2 + 3(0.5)^2 + 4(0.5)^2$. There is a question mark written below the first term, $1(0.5)^2$.

Grader 2



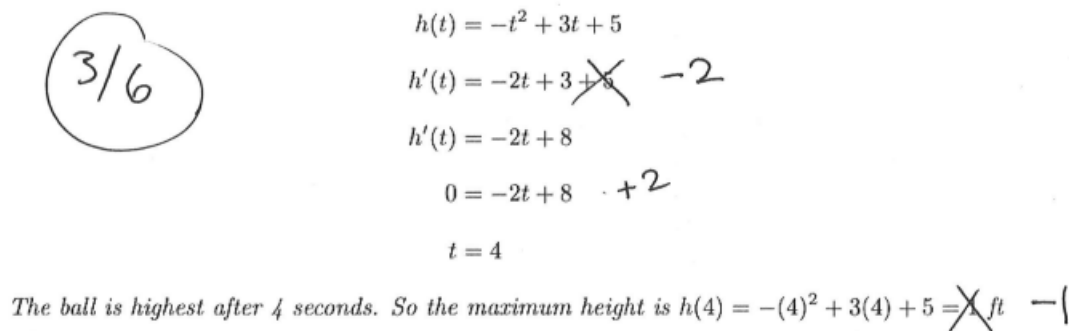
The student's work is the same as in Grader 1. Grader 2 has circled the coefficients 1, 2, 3, and 4. A handwritten note "not quite" with an arrow points to the first circled coefficient, 1. Another handwritten note "should be area of rectangle" with an arrow points to the second circled coefficient, 2.

The Experiences that Influenced my Grading

The following reflective essay was written by a mathematics graduate student about personal experiences that influenced their grading within their first two years of graduate school. There are many nuances of grading – it takes time to develop the ability to grade in a way that fairly assess what students know. The goal of this essay is not to teach you how to grade fairly, but to get you thinking from now about the value in taking an empathetic and student-centered approach in grading. These are things you'll want to be thinking about when you grade in the (near) future.

I had the opportunity to experience many things for the first time within my first year of grad school. One of these things was grading – my undergraduate university was small and didn't have anything like teaching or grading assignments for its mathematics majors. This didn't concern me, though, I felt like grading couldn't be that hard. You're given a set of rules that define a way to assign a number to each question on an exam by identifying the errors and deducting points. Really, it felt border-line autonomous.

I'd like to share how I would have graded something near the start of my first year. In Calculus I, a common exam problem is to ask something like, "The height (in feet) of a ball t seconds after being thrown is given by $h(t) = -t^2 + 3t + 5$. At what time is the ball highest? What is the maximum height of the ball?" A sample rubric for this problem would be to give the student 2 points for correctly taking the derivative, 2 points for setting the derivative equal to 0 and solving for t correctly, and 2 points for finding the maximum height correctly. Here is how I would have graded the following sample student response to this question (the student work is typed, my grading is represented by the hand-written marks and comments):


$$\begin{aligned} h(t) &= -t^2 + 3t + 5 \\ h'(t) &= -2t + 3 + 6 \quad \text{X} \quad -2 \\ h'(t) &= -2t + 8 \\ 0 &= -2t + 8 \quad +2 \\ t &= 4 \\ \text{The ball is highest after 4 seconds. So the maximum height is } h(4) &= -(4)^2 + 3(4) + 5 = \text{X} \quad -1 \end{aligned}$$

My perspectives on grading didn't stay the same for very long. As I mentioned, I had the opportunity to experience many things for the first time in my first year of grad school – grading was just one of them. Another has to do with my experiences learning and interacting in my classes.

Though I would never consider myself particularly amazing at mathematics, I felt like I had the ability to at least understand what was going on in a class, and felt fairly comfortable asking questions in a class if I needed further clarification. Actually, speaking up was fairly regular for me in a class – my classes were pretty interactive and I felt confident enough in my knowledge to contribute to in-class discussions.

This changed rather quickly when I started grad school. As my first semester progressed, my ability to follow lectures decreased. It didn't help that, at the time, it felt like things were really obvious to everyone around me. People were asking questions at such a high level – sometimes, I didn't completely understand what they were asking. I stopped asking questions in my classes because I felt too embarrassed to ask anything. What if the professor thought poorly of me because of my question? What if I can't even understand their response? I quickly fell victim to impostor syndrome.

My psychological state didn't remain this way forever, even though grad school continued to be challenging. I quickly found out that many other people in my cohort felt the same as I had, and knowing that I wasn't the only one feeling this way really helped. By the end of my first year, I was really happy with where I was and what I was doing.

As I reflected on this insecurity, I realized that the students I taught may also be dealing with similar thoughts. This ended up influencing my thoughts on grading. For example, if I took an exam and my professor was grading it, I wouldn't want them hunting for all my mistakes. Learning had become such a challenge for me, that I wanted my professors to be looking for the things I was able to learn. Don't get me wrong, I wanted constructive feedback on my mistakes, but I didn't want my grade to be representative of the things I didn't learn, I wanted it to represent what I did learn.

Extending this to my own grading, what I realized was that when I was originally grading a question, all I was thinking about was the mistakes in an answer, when really, I needed to be thinking about the student, looking for the things that they did well, the things they did understand. After all, it's what I would have wanted graders to do with my work.

This was the first time feelings of empathy contributed to what has now become my philosophy on grading, and it has continued to influence it in other ways. Another example of this was actually something that actually came from a convener of a course I was teaching. He specified to not cross out students work because it felt disrespectful – it devalues any productive thoughts they were having about the problem. Plus, it could cover up their work and make it harder for them to look back and learn from their mistakes. He suggested circling or underlining incorrect parts of problems as a more productive way to call attention to them. I realized he was right – I would have felt pretty bad if I spent an hour writing up what I thought was a good proof for something, only to have a professor cross it out in thick red ink. Crossing work out is just one example of an unproductive thing that a grader can write on a students work. I also learned that although squiggling down a question mark is a convenient way to send the message to the student that their work doesn't make sense, it basically tells the student “what were you even thinking?”, which is definitely not something I'd want to be told to me if I spent a bunch of time trying to do the best I could on a problem.

I'd like to now share how I would now grade the problem I provided towards the start of this essay. Recall that the question was "The height (in feet) of a ball t seconds after being thrown is given by $h(t) = -t^2 + 3t + 5$. At what time is the ball highest? What is the maximum height of the ball?" The sample rubric that came with it was to give 2 points for correctly taking the derivative, 2 points for setting the derivative equal to 0 and solving for t correctly, and 2 points for finding the maximum height correctly. With the way I currently think about grading, I would've started by rewriting the rubric to specify that students should get a point for attempting to take the derivative, and then another point for doing so correctly. Students should be rewarded for knowing that a part of the process was taking the derivative. I would then feel comfortable to grade the problem.

$h(t) = -t^2 + 3t + 5$
 $h'(t) = -2t + 3 + 5$ *care full*
 $h'(t) = -2t + 8$
 $0 = -2t + 8$
 $t = 4$
 $+2$
 The ball is highest after 4 seconds. So the maximum height is $h(4) = -(4)^2 + 3(4) + 5 = 1$ ft

There are a several differences to note with how I graded before, but I'll only mention a couple, and leave the rest as an exercise to the reader. First, notice that I ended up rewarding the full two points for finding the maximum height, even though the answer itself was wrong. Clearly, the student understands that the maximum height is achieved at the value of t so that $h'(t) = 0$. Since they got that this value was 4, it should be expected that they think the maximum height is at $h(4)$. (This way of grading, in particular, avoids an issue called double-jeopardy, where a student is punished multiple times for a single mistake they made.) The other thing I did that I would like to mention is that I only gave positive point values, never negative ones. This is because I want to convey to the student that I am rewarding them for the things they did correctly, not punishing them for the things that they did wrong. I could imagine a student seeing a page with a lot of negative points and feeling so overwhelmed that they made a bunch of mistakes, to the point that they don't even want to try to figure out what they did wrong. My hope with using only positive points in that it's more of an encouragement that they successfully learned certain concepts.

Grad life experiences and empathetic impulses were largely important in my ability to shift from a autonomous state of grading to a more student-focused one, but this wasn't the case for everyone in my cohort, particularly because not everyone had the same grad life experiences that I had. For example, I had one particular friend in my cohort who never really felt lost, or afraid to ask questions, during his first year

of grad school. Basically, his first year academically was almost opposite of mine. The thing that impacted how he graded was having the opportunity to teach their own class, and having to grade his own students' work.

His challenges with grading came from an inability to empathize – he had always been good at math, and as a consequence, he had a hard time understanding the kind of mistakes his students made, especially if they were on things that felt fundamental like arithmetic. Without having a firm grasp of the basics, it's difficult to proceed in mathematics and really understand what is going on. As a result, when he was grading at the start of grad school, he felt like students making such fundamental errors were completely lost and didn't really know what was happening, and hence didn't deserve many points. As an example, consider the following work to solve for x :

$$2x + 3 = 5$$

$$2x = \frac{5}{3}$$

$$x = \frac{5}{6}$$

My friend would have thought that the student deserved about half credit, since they couldn't possibly know what was going on if they were making a mistake like dividing instead of subtracting.

But then my friend started teaching, and when he found so many of his students making the same type of fundamental errors as each other, he realized his expectations of what students should know coming into his class were beyond unrealistic. He learned it was a bit unfair to assume what students did and did not know, as everyone has different mathematical experiences, and realized that what he should be grading them on is not what they should already know, but what they have successfully learned in his class. This means that, given an exam problem, if a student's work shows that they understand what the question is asking them to do, the student deserves most of the points. For example, in the solving for x example above, he now would probably give them most of the points since the work demonstrates an understanding that the phrase "solve for x " means "try to manipulate the equation algebraically in order to get an expression for x ", which is really what that question was testing. The fact that they made an arithmetic error doesn't change the fact that they understand what the question was asking for. He also realized that by taking off a lot of points for such an error, he wasn't necessarily sending the message that there was an error in the problem, but that they just did the whole problem wrong.

There are a lot of nuances in grading, and random challenges always arise. What's important, in all cases, is to grade with the intention to see what students learned successfully and to try to be respectful towards student's work.

Post-Reading Discussion Questions

1. Look back to your response to question 3 in the pre-reading discussion questions. Do you still agree with what you said? Do you see anything you missed before that is either good or bad?
2. The essay mentioned that crossing out student work and using question marks are two things that can send the wrong message to a student when they look at their graded work. Can you think of other things that would be unproductive to put on student work? (Feel free to use personal experiences.)
3. In what ways do you feel your personal experiences with math will be the same as the students you teach? In what ways do you feel will they be different?
4. You are likely teaching recitations for Calculus I or II this semester. What would you consider prerequisite knowledge to these courses? In other words, what things do you feel are fair to assume students are able to do if they are taking these courses?