PROFESSIONAL DEVELOPMENT WORKSHOP · SPRING 2006
ASSIGNMENT 10

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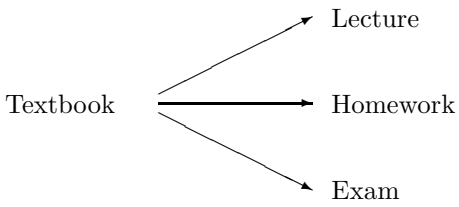
Writing Tests

How do you determine the content/topics that you will include on a test? How do you use the book as you construct a test?

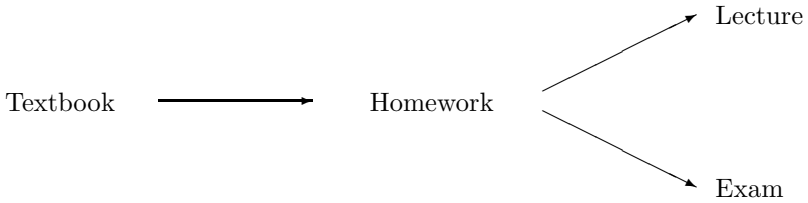
The exam questions should be minor varations on the homework, just as the lecture should be primarily directed toward concepts and skills needed to do the homework. Last semester, I would get the list of topics directly from the text, then write an exam to test over those topics. This semester, I am taking topics from homework and quizzes, which *in turn* are obtained from the text.

I asked the department for the long evaluation forms last semester; as a result, I got quite a bit of specific feedback. One common complaint on the evaluations was that lectures, homework, and exams didn't match. I would map from the textbook to the lectures, from the textbook to the homework (via assigned problems), and from the textbook to the exams, as follows:



This made sense to me. If the students understood the concepts, they could do the homework problems and the exam problems. But what was straightforward to me was not always straightforward to the students.

Now, I am attempting to get the homework problems to be the complete list of topics for the course, so that I can base my lectures on how to work the homework problems, and write my exam questions from there:



A minor point: Last semester, I adapted some exam questions from the previous semester's final review. In particular, for exam 1: Which of $y = x$, $y^2 = x$, and $y^3 = x$ represent y as a function of x? I thought the question was fair since it appeared early on in the final review; also, my supervisor liked the question. Students should be able to do this problem *in principle*, but in fact, a true understanding of this problem requires the concept of 1-1 functions, which weren't covered on exam 1. And, I'd not lectured on this

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particular type of problem. I overestimated how big a leap of insight students would be able to make. As a result, almost no one got this question correct.

Most tests have a mix of question styles: computational vs. conceptual; short answer vs. essay vs. multiple choice; etc. How do you determine a good mix of styles?

I want to give students opportunities to show me *different ways* they might understand something. Last semester I wrote my exam questions one section at at time. E.g. the first exam was over sections 1.1 through 1.4, so I wrote 3-4 questions, one for each section. That seemed to be a reasonable way to proceed. However, this would give students only one way to exhibit understanding. For example, to me, even/odd symmetries are a *single concept*; the algebraic (i.e. $f(-x) = \pm f(x)$) and graphical (i.e. mirror/rotational symmetry) viewpoints are manifestations of that single concept. A student, though, might get one viewpoint (say, the graphical version) while missing the other (say, the algebraic). So, I want my exams to measure what they do and don't know, in whatever ways they do and don't know it.

A minor point: I don't much like multiple-choice questions, but I always give some so that students won't be completely taken by surprise on the all-multiple-choice final.

How did your students do on exam 2 last semester?

The class average for exam 2 was 67%. There were 8 E's, 6 D's, 8 C's, 4 B's, and 1 A — with the later being a 90%. The student with the 90% was stellar all semester — I suspect the only reason she placed into 110 was due to her poor English skills (she is a foreign student).

The chief complaint from students (other issues are noted below) was that the exam was too long. I didn't time myself taking it (the first and last time I ever make that mistake!); my supervisor took the exam and thought the length was OK. I didn't verify that for myself.

I was horrified by the outcome. I was greatly disturbed by my supervisor's judgment that these scores were "completely normal" and didn't need adjusting. This is a dreadful fact of current 110 policy. As a first-time instructor, I wrote an exam which I am my supervisor both liked; the results were bad, and it was clear in retrospect that some of those poor results were my fault as an instructor. The students should have been penalized for their amateurish performance; they should not have been penalized for mine. But they were.

What changes do you plan to make with exam 2 for this semester?

The exam problems I took from the final review all turned out to be horrible in terms of student performance. Yet, my class did have average performance on the final. So, I will not look at the final-review document until the *appropriate* time, which is during review for the final.

I will not make all-but-identical questions. For example: let $r(t) = |t - 1|$ and $s(t) = \sqrt{t - 5}$. Part (a): find the composition $r(s(t))$. Part (b): find the composition $s(r(t))$. For a *lecture*, or for a *homework*, it's very important to make the point that composition is not commutative. For an exam, though, if a student can't compose $r(s(t))$, then they won't be able to compose $s(r(t))$. I'll have discovered that fact *twice*, and I'll have deprived them of the opportunity to show me something *else* which they *do* know.

On exam 2, I wrote a question where the students were given a graph of a parabola with vertex and y-intercept labeled, and were asked to write its equation in general form, i.e. $y = ax^2 + bx + c$. This seemed fair, but in fact, this is *two* questions. The first part is converting from the given data to standard form, i.e. $y = a(x - h)^2 + k$, and the second is converting from standard form to general form. Now, one improvement would be to make it a two-part question. But, if they miss the first part, they can't possibly get the second part right. So, I could tell them the following: if you don't get part (a), then for part (b) just make up an equation in general form and convert it to standard form. Or, I could simply ask two separate questions.

The previous paragraph brings up a general point: it's important to recognize multi-step problems as *being* multi-step. On exams — where students only have 3-4 minutes per question — don't ask problems with multiple steps. Save the lengthy problems for the homework where they belong.

What aspect(s) of writing tests do you find most difficult or time-consuming?

Writing an exam is certainly time-consuming. But, I don't think there's any particular aspect which is lengthy. My steps include (*) selecting the topics, (*) making sure that at least one question (preferably more, as above) addresses each topic, (*) finding different ways to ask questions (verbal, graphical, algebraic, tabular), (*) typesetting, (*) proofreading and general second-guessing, (*) taking the exam myself, (*) going through markups and revision(s) with my supervisor, and (*) getting it copied.

Looking ahead to a future class: What topic or topics did you find the most difficult to teach?

None, really ... I suppose, section 1.5 (transformations). I wanted to make it clear why we have $-h$ for horizontal translations, but $+k$ for vertical translations. In fact, I don't think my eloquence was up to the task. This time, I'll spend the first day (tomorrow!) doing a discovery approach with the workbook — so that they can convince *themselves* using *their* reasoning.

The previous paragraph brings up a more general point — this semester I am trying to talk less. I am stewing (a bit) less over my lesson plans. In fact, the most important things in class happen when I am *not* talking — when I've asked students a question and I am waiting for an answer, when students are working problems, when they are collaborating with one another, etc.