Piecewise Specifications-based Grading

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Outline:

- Issues with student performance in traditional grading scheme (points)
- How specifications grading can address these issues
- Using a piecewise approach (case study)

Trying to learn under grade pressure

Another reason that physics students learn by rote

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American Journal of Physics **67**, S52 (1999)

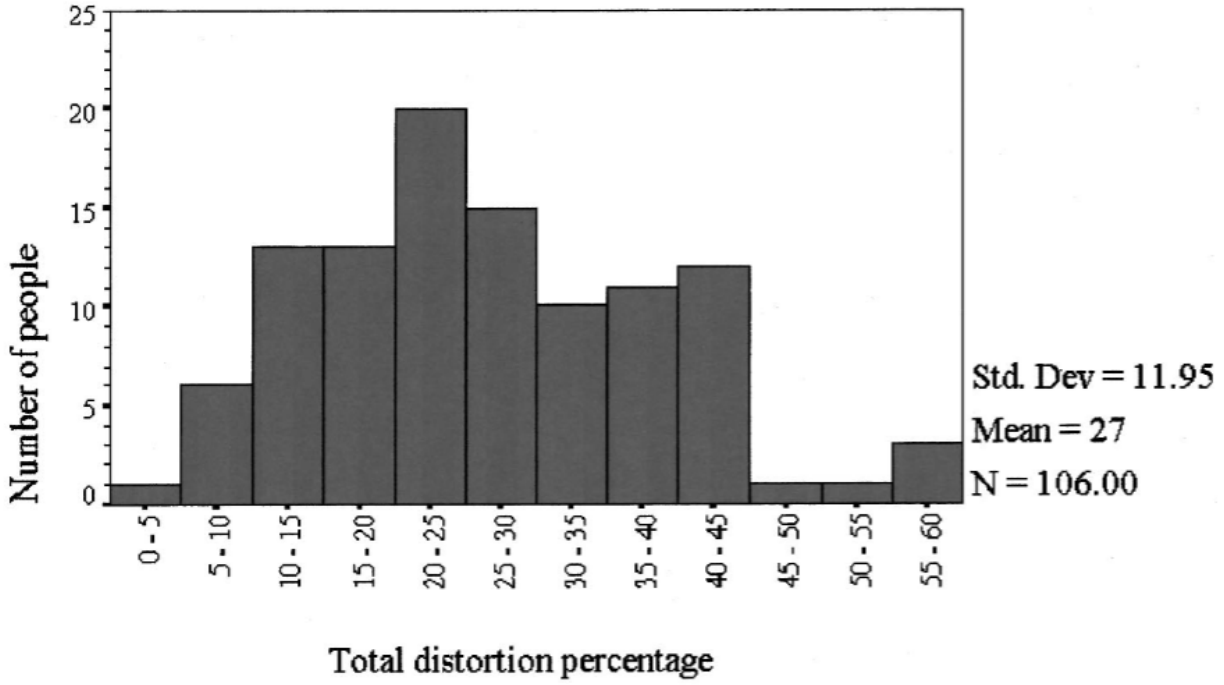

Fig. 1. Distribution of total distortion percentages. A student's ''total distortion percentage'' quantifies the difference between her own study time allocations and the allocations she recommends to a hypothetical student who is pursuing a deep understanding of physics, with no grade pressure.

Students knowingly maximize points over maximizing learning.
Instructor's role to incentivize positive habits.

Why specifications grading?

- Shift the focus from students managing points to understanding material.
- Provides organic opportunity for feedback/revision cycle.
- It can support principles of Deliberate Practice.

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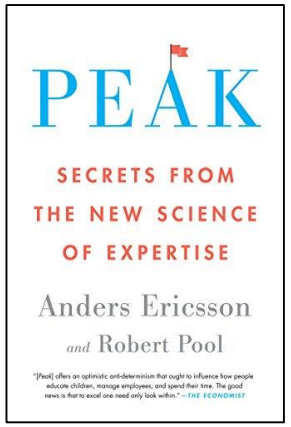
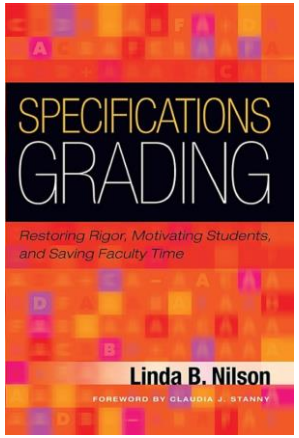




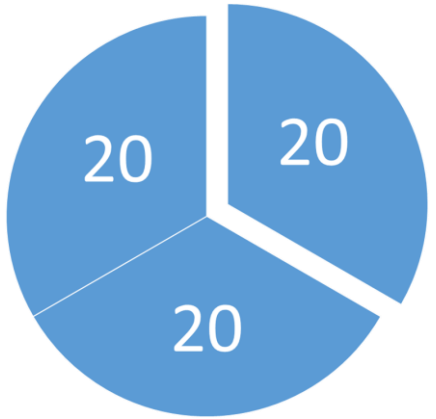
Focus today

Piecewise philosophy

- Implement one new course category at a time (Labs)
- Multi-year plan
- Revise from year to year

Case Study: PHY 234

- E&M, Optics
- Moderately large class: 40-60 engineering majors.
  - Strategies designed with scaling to 100 students in mind.
- Break up into Lab/Discussion of 20 students each.
  - Experimental work
  - Tutorial exercises
  - Quantitative problem sets



Year 1 - Fall 2016: No specs (baseline)

- Everything graded with points
- Reframe each activity as separate opportunity for healthier learning/feedback cycle

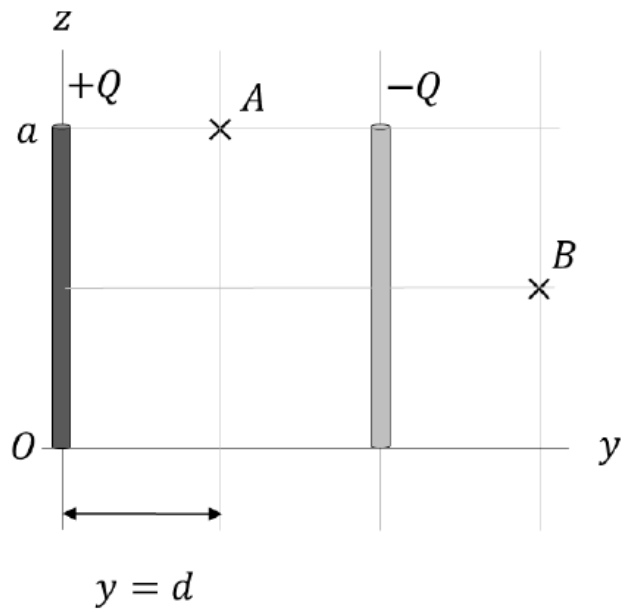
Course Activity	weight
Quizzes	10%
Homework	15%
Lab/Discussion	10%
Best Midterm	15%
Other Midterm	15%
Lowest Midterm	10%
Final Exam	25%

Grade	Weighted Average
A	> 93%
A-	> 90
B+	> 87
B	> 83
B-	> 80
C+	> 77
C	> 73
C-	> 70
D+	> 67
D	> 60
F	< 60

Representative Lab/Discussion Problem

a. Draw an arrow on the figure at both locations A and B showing the direction of the net electric field at those locations. Write '$E = 0$' if the field is zero there.

b. Calculate the net electric field produced by the charge distribution at location A.



What is contained in ideal student solution?

Grading student problem solutions: The challenge of sending a consistent message

themes that appear to shape grading decisions: (1) a desire to see student reasoning, (2) a reluctance to deduct points from a student solution that might be correct, and (3) a tendency to project correct thought processes onto a student solution. When all three themes were expressed by an instructor,

Henderson, *et al.*, *American Journal of Physics* **72**, 164 (2004).

Lab/Discussion Specifications (from Syllabus)

Lab/Discussion Grades and Specifications

Each week's entire lab/discussion will be evaluated as one of the following:

S: Satisfactory – All three specifications are met.

P: Progressing – At least one of the specifications is not yet met.

I: Incomplete – All questions and problems should receive a good-faith attempt and be complete. If they are not, the lab/discussion receives an incomplete. I may still be revised once.

Specifications:

1. **Clear.** All work is clear and legible. Physical reasoning is explained where appropriate.
2. **Plausible.** Experimental data are plausible, or there is an explanation for why they are not plausible, specifically identifying what went wrong.
3. **Mostly Correct.** *Most* of the work is fully correct. Depending on the lab, "most" may be as low as 70% or as high as 100%.

Revisions: Any lab/discussion receiving a 'P' or 'I' mark may be revised once, with a due date for the revision of one week after it is returned to you. Lab/Discussions originally turned in after the due date forfeit the revision privilege.

Revisions

- Students receive lab/discussion back with comments promoting growth.
- Revisions accepted up to one week after handing back
- Revisions must include reflections.
  - What was the inadequacy
  - How was it improved in revision?

<u>Scaling to large courses:</u>

- Each revision opportunity is *N*-multiplier for one instructor
  - Compare N=10 vs. N=60

Year 2 - Fall 2017: Specs grading of Lab/Discussion

Grade	Weighted Average
A	> 93%
A-	> 90
B+	> 87
B	> 83
B-	> 80
C+	> 77
C	> 73
C-	> 70
D+	> 67
D	> 60
F	< 60

Fall 2016

Lab/Disc. excluded

Grade	Weighted Average	Number of Satisfactory marks on Lab/Discussion (out of 13)
A	> 93%	12 or more
A-	> 90	
B+	> 87	11 or more
B	> 83	
B-	> 80	
C+	> 77	10 or more
C	> 73	
C-	> 70	
D+	> 67	9 or more
D	> 60	
F	< 60	Less than 9

Fall 2017

Student Comment

"The lab revision policy made me fell less pressured to allow the individual at the table who was the best at physics lead and place my own thoughts and answers on the labs. This, of course, led to a better understanding. The policy encouraged me to understand the material as opposed to just agreeing with someone at the table who is good at physics then just writing down what they have."

Summary

- My own observations:
  - Clear shift in conversations with students - From points earned to what was learned.
  - Incentivizes tweaks in behavior - Return to improve work, rather than toss it.
- Specifications-based grading can shift focus from gaming points to student control of learning
- Piecewise implementation can make conversion manageable
  - Scaling up to larger courses
  - Gradual over several years

Acknowledgement

SBSG learning community mates at Grand Valley State University:

Rob Talbert, Stephanie Shaertel, Taylor Short, Ginger Rohwer