Introduction to Specifications Grading

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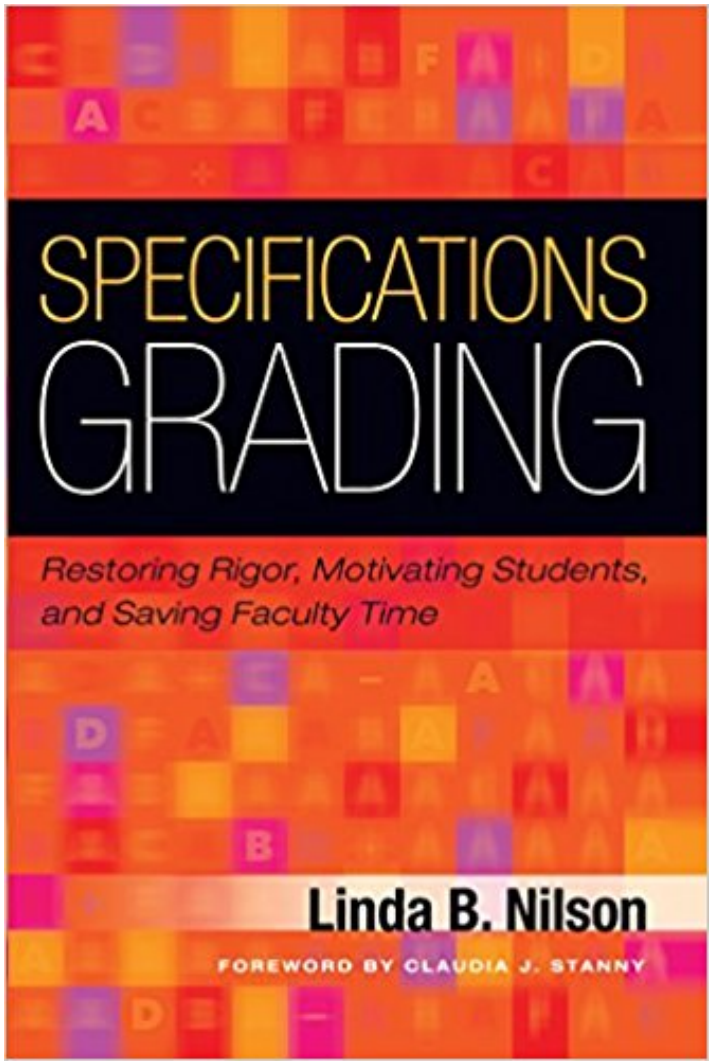
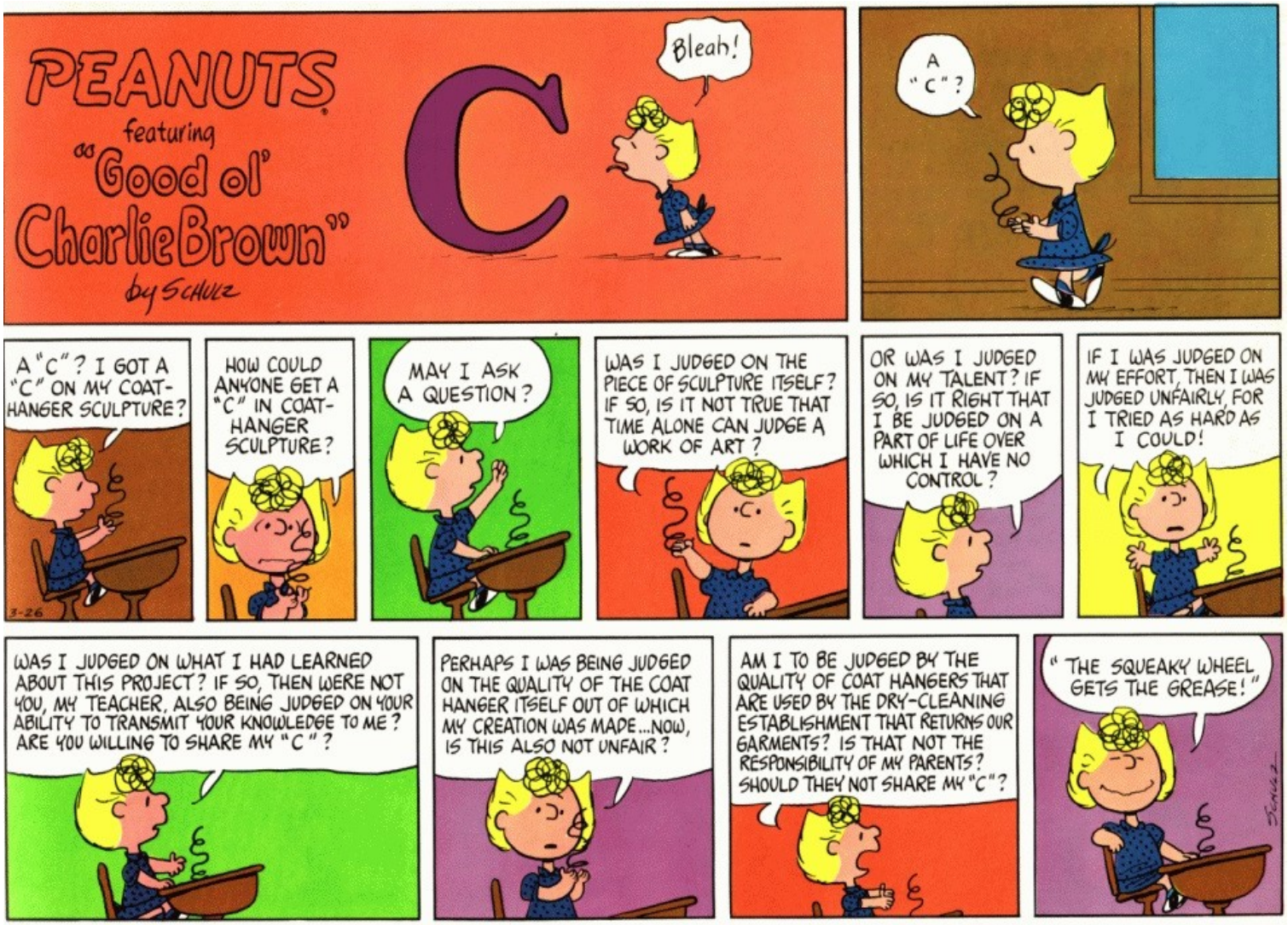
The book is a great motivator, but lacking on STEM examples.




PEANUTS
featuring
"Good ol' CharlieBrown"
by Schulz
C
Bleah!
A "C"?
A "C"? I GOT A "C" ON MY COAT-HANGER SCULPTURE?
HOW COULD ANYONE GET A "C" IN COAT-HANGER SCULPTURE?
MAY I ASK A QUESTION?
WAS I JUDGED ON THE PIECE OF SCULPTURE ITSELF? IF SO, IS IT NOT TRUE THAT TIME ALONE CAN JUDGE A WORK OF ART?
OR WAS I JUDGED ON MY TALENT? IF SO, IS IT RIGHT THAT I BE JUDGED ON A PART OF LIFE OVER WHICH I HAVE NO CONTROL?
IF I WAS JUDGED ON MY EFFORT, THEN I WAS JUDGED UNFAIRLY, FOR I TRIED AS HARD AS I COULD!
3-26
WAS I JUDGED ON WHAT I HAD LEARNED ABOUT THIS PROJECT? IF SO, THEN WERE NOT YOU, MY TEACHER, ALSO BEING JUDGED ON YOUR ABILITY TO TRANSMIT YOUR KNOWLEDGE TO ME? ARE YOU WILLING TO SHARE MY "C"?
PERHAPS I WAS BEING JUDGED ON THE QUALITY OF THE COAT HANGER ITSELF OUT OF WHICH MY CREATION WAS MADE...NOW, IS THIS ALSO NOT UNFAIR?
AM I TO BE JUDGED BY THE QUALITY OF COAT HANGERS THAT ARE USED BY THE DRY-CLEANING ESTABLISHMENT THAT RETURNS OUR GARMENTS? IS THAT NOT THE RESPONSIBILITY OF MY PARENTS? SHOULD THEY NOT SHARE MY "C"?
"THE SQUEAKY WHEEL GETS THE GREASE!"
Schulz

We should critically evaluate our grading system.

Activity [Worksheet 1]:

Consider the grading system you currently use:

- what does your current grading system do well?
- what is broken about your current grading system?

Please introduce yourself.

Discussion:

- What is your name?
- In which department do you teach?
- What is your biggest pet peeve about grading currently?
- What course do you envision using specifications grading?

What does your ideal system look like?

- Uphold high academic standards
- Reflect student learning outcomes
- Motivate students to learn
- Motivate students to excel
- Discourage cheating
- Reduce student stress
- Make students feel responsible for their grades
- Minimize conflict between faculty and staff
- Save faculty time
- Give students feedback they will use
- Make expectations clear
- Foster higher-order cognitive development and creativity
- Assess authentically
- Have high interrater agreement
- Be simple

Basic recipe for a simple specs grading system.

1. **Objectives.**
2. **Categories and benchmarks.**
3. **Mastery based testing.**
4. **Specifications.**
5. **Grading and rewrites.**

Basic recipe for a simple specs grading system.

1. **Objectives.** Split up course material and goals into a reasonable number of manageable parts or objectives. An objective is something that you can measure. It is something for which you can write down specifications of passable work.
2. **Categories and benchmarks.**
3. **Mastery based testing.**
4. **Specifications.**
5. **Grading and rewrites.**

Basic recipe for a simple specs grading system.

1. **Objectives.**
2. **Categories and benchmarks.** Choose categories of work and assessments that students must complete to practice the material, demonstrate mastery of the objectives and ultimately earn their grade. Set grade benchmarks in each category.
3. **Mastery based testing.**
4. **Specifications.**
5. **Grading and rewrites.**

Basic recipe for a simple specs grading system.

1. **Objectives.**
2. **Categories and benchmarks.**
3. **Mastery based testing.** If your course includes exams and/or quizzes, use mastery based testing (MBT) to give students multiple chances to demonstrate mastery of the objectives.
4. **Specifications.**
5. **Grading and rewrites.**

Basic recipe for a simple specs grading system.

1. **Objectives.**
2. **Categories and benchmarks.**
3. **Mastery based testing.**
4. **Specifications.** Give the students a list of specifications (specs) that their work must meet in order to pass. You can give these specs assignment by assignment, or you can give specs all at once to cover a certain category or type of work.
5. **Grading and rewrites.**

Basic recipe for a simple specs grading system.

1. **Objectives.**
2. **Categories and benchmarks.**
3. **Mastery based testing.**
4. **Specifications.**
5. **Grading and rewrites.** Grade most things pass/no pass. Allow rewrites to a reasonable extent.

Specifications Grading forms a chain in the course.

- Potential grades in a course are chosen to reflect course outcomes.
- Assignments are linked to assessing particular course outcomes.
- Completion of an assignment is determined by whether the student meets the predetermined set of specifications attached to the assignment.
- The grade a student earns depends on the collection of assignments completed.

Our road map for today.

- Examine the design of our course.
- Confront our fears of pass/fail grading.
- (Next Time:) Communicate to students our expectations on an assignment.
- (Next Time:) Link assignments to grades in the class.
- (Next Time:) Address questions about implementation.

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Pick a course (or an assignment within a course) that you would like to work with throughout the workshop.

Course design depends on well-written learning objectives.

A learning outcome is an observable ability or skill that a student is supposed to acquire by the end of a learning unit... (page 17)

Well-written learning objectives convey a lot of information.

Example

(Poorly Written Objective) Understand a sampling distribution and how it applies to making statistical inferences based on samples of data.

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(Poorly Written Objective) Understand a sampling distribution and how it applies to making statistical inferences based on samples of data.
Alternatives:

- **Define** what is meant by the *sampling distribution* of a statistic.
- **State** the conditions required for applying the Central Limit Theorem: sample is drawn at random from the population; sample size is large; population has a finite mean.
- Given the mean and standard deviation for the population, **compute** the probability that the sample mean for a random sample of size n would exceed a specified threshold.
- **Discuss** the role of the sampling distribution when computing a p-value.

Objectives should link to assessment.

Objective from MA482 (Bioengineering Statistics)

Assess the strength of evidence presented by a scientific publication in addressing a research question and **provide** constructive feedback for improving a study.

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Assess the strength of evidence presented by a scientific publication in addressing a research question and **provide** constructive feedback for improving a study.

Corresponding Assessment

Review an assigned article from medical literature.

Objectives should link to assessment.

Objective from MA 212 (DE II)

Recognize and solve separable differential equations by hand

Objectives should link to assessment.

Objective from MA 212 (DE II)

Recognize and solve separable differential equations by hand

Corresponding Assignments and Assessments

- Homework
- Quiz/Exam Problem: Find the general solution to the differential equation. Solve for y explicitly.

$$\frac{y}{x}\frac{dy}{dx} = \sqrt{4 - x^2}$$

Homework: write your learning objectives.

Homework [Worksheet 2]:

Prior to our next meeting, we encourage you to develop your course-level learning objectives. Then, for each of those, write the additional unit-level objectives which support it and then begin mapping assessments to those objectives. Keep the following in mind:

- Is the outcome measurable?
- Have you assessed the objective authentically?
- Will you need multiple assessments to adequately measure the outcome?

Note: you may find that instead of redesigning your course, you may want to only redesign a particular activity; then, instead of course-objectives, you would only need the assignment objectives.

Grades are determined by the assessments students successfully complete.

Example from DE-II:

	A	B	C	D
Online HW	85%	80%	75%	70%
Wksheets	Pass all but 1	all but 2	all but 3	all but 4
Problems	20 (of 20)	17	14	12
Projects	Pass 2	Pass 1	Pass 0	Pass 0
Final Exam	85%	75%	65%	55%

Plus grades are assigned over the base grade if there are at least 2 categories in which the student has met the benchmark for a higher grade.

Grades are determined by the assessments students successfully complete.

Example from Disco:

	A	B	C	D
Wksheets	Pass all but 1	all but 2	all but 3	all but 4
Problems: Core	Pass all 6	Pass 6	Pass 6	Pass 5
Problems: Adv.	Pass 5	Pass 3	Pass 1	Pass 0
Final Exam	85%	75%	65%	55%

A student earns a plus grade by having at least one category in which they have met a benchmark for a grade higher than their base grade.

In general, there are three paths from assessments to grades.

1. *More hurdles:* higher grades are earned by completing more assignments.
2. *Higher hurdles:* higher grades are earned by completing assignments which demonstrate deeper learning.
3. *Both:* higher grades are earned by some combination of the above.

Homework: what really matters?

Homework [Worksheet 3]:

Prior to our next meeting, think about the following questions:

- What is the "must have" for your course? (This helps you define a D in the class)
- What is the optional but distinguishes mastery of the content from a working knowledge? (Begins to distinguish various grades)

All assignments are to be graded pass/fail.

If you are like most faculty, you are sometimes unhappy with the quality of the work your students hand in, and you know they could do better if they just made the effort and took the time. Often enough to raise concern, they do not follow directions, answer the question, or complete the problems or writing task. Other times they do a shallow job, spending only minutes the previous night or just before class whipping out an assignment that should have taken them at least one or two hours. It seems they are not trying very hard. But why should they? We will accept the work to grade and will look for things to give them points for... (page 47)

Pass/Fail grading scares people.

Discussion:

- What fears do you think students have about pass/fail grading of all assessments (questions, exams, projects)?
- What fears do you have about pass/fail grading?

What makes pass/fail unfair?

Example

(Hypothetical Question) In his attempt to spoil Christmas, the Grinch stole 22 presents and 11 stockings from the home of Cindy Lou Who. How many items did he steal in total? Explain how you got your answer.

1. 33.
2. 33, because $22 + 11 = 33$
3. 33. "Totals" are determined by addition of all items (both presents and stockings). If we add 22 and 11, our solution is 33.
4. 34. If you begin at 22 on the number line and take 12 hops forward, you land on 34.

What makes pass/fail unfair?

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Pass/fail is unfair when students do not know where the bar is.

Pass/Fail grading is not sufficient.

What are we really assessing when we are grading pass/fail? We are assessing whether a student's work meets certain specifications – that is, one or more requirements that we set for a piece of student work. (page 56)

Specifications provide the roadmap.

Example from MA212 (DE II)

A **Pass** on a worksheet is earned by submitting write-ups of worksheet questions that meet the following criteria:

- Submitted by the deadline
- Answers are written up neatly with adequate room (at least 4 in^2) to write comments. Papers should be stapled and your CM number should appear on the first page along with your name.
- All collaborators and outside sources are cited, including Maple/Calculators.
- Any Maple output included in the answer is neatly presented and annotated with comments in English explaining what you're doing with Maple step by step. Delete any irrelevant Maple output, and clean up or summarize anything excessively long.
- Demonstrates a good-faith effort to do all questions on the assignment correctly and completely. More specifically:

Specifications provide the roadmap.

Example from MA212 (DE II)

A **Pass** on a worksheet is earned by submitting write-ups of worksheet questions that meet the following criteria:

- Demonstrates a good-faith effort to do all questions on the assignment correctly and completely. More specifically:
  - All questions should be attempted. Answers *need not* be perfect, but should reflect an investment of time and attention given to the problems. Skipping a question or writing "I don't know how to do this question" or "ran out of time" counts as a major mistake.
  - Most minor mistakes will be forgiven, and a few major mistakes may be allowed (around 1 – 3 depending on length of the assignment). More than a few major mistakes will lead to a **No Pass**.
  - Answers are clearly presented and organized, including all relevant work *and explanations* in English/Math-speak to justify your answers.

Specifications provide the roadmap.

Example from MA481 (Bioengineering Statistics)

Successful completion of an Article Review entails a "good faith effort." Specifically, the following is required to satisfy a good faith effort:

- Your score sheet, with comments, is uploaded by the due date.
- At least one substantial comment is made regarding each category. A comment is substantial if, in the judgment of the instructor, an honest attempt was made to critique the paper (positively or negatively) **and** evidence from the paper is cited.

Note: your opinion of th earticle does nto factor into your grade (you can love it or hate it and still receive credit for the assignment).

Specifications provide the roadmap.

Example from MA275 (Disco)

Specs for Proofs: Your proofs must meet standards of **readability, validity** and **fluency**.

- **Readability**
- **Validity**
- **Fluency**

Specifications provide the roadmap.

Example from MA275 (Disco)

Specs for Proofs: Your proofs must meet standards of **readability, validity** and **fluency**.

- **Readability**
- **Validity** The logical form of the argument must be valid. Every assertion in the proof must be backed up by a definition, a logical rule, previous work in the proof, or a theorem.
- **Fluency**

Specifications provide the roadmap.

Example from MA275 (Disco)

Specs for Proofs: Your proofs must meet standards of **readability, validity** and **fluency**.

- **Readability**
- **Validity**
- **Fluency** This is your ability to use correct, established notation, definitions and terminology in your proof. It is a measure of how fluent you are in the "language of mathematics," and with the subject material of your proof. (It is possible to write a highly *readable* proof, with low fluency, e.g. by using informal, incorrect terminology.) You must demonstrate a mastery of the terminology and precise language necessary for the proof.

Specifications provide the roadmap.

Example from MA275 (Disco)

Specs for Proofs: Your proofs must meet standards of **readability, validity** and **fluency**.

- **Readability** If your work is not easily readable, it cannot be assessed.
  - All assumptions must be stated explicitly. The overall conclusion must be stated explicitly at the end.
    Write your proof so that, if your proof were separated from its theorem, a reader could write down the statement of the theorem by reading your proof.
  - Conversely, don't include statements that are NOT assumptions unless you explain clearly. For example, sometimes people will include a statement of their desired conclusion. But, if this is not clearly explained, then the reader may think that your proof is circular.
- **Validity**
- **Fluency**

Specifications provide the roadmap.

Example from MA275 (Disco)

Readability:

- Proof techniques (other than direct proof) should be named explicitly, so the reader can easily follow your logic. Phrases like "assume towards contradiction" and "We will proceed by proving the contrapositive..." can be helpful.
- Grammar and punctuation should be correct.
- Use precise, specific language. **Avoid** using vague words like "it" or "the set." Instead, give the name of the object to which you are referring.
- Give clear reasons for conclusions in the proof. Reasons that are not direct, simple uses of definitions or logical rules should be explicitly stated.

Specifications provide the roadmap.

Example from MA275 (Disco)

Readability:

- Do not make large logical leaps without explanation. If you think a conclusion is "obvious," *you should be able to cite a definition or rule, or write down a short argument to prove it.*
- Do not include irrelevant detail
- You do NOT need to restate definitions inside a proof.
- If you invent symbols that don't have outside definitions, you need to say explicitly what those symbols stand for. (Define your "notation.")
- Strings of equations with no explanation are unacceptable, as are random words or sentences with no logical connection.

Tips for writing specifications.

- Keep the specifications simple.
- Keep the specifications precise.
- As a faculty member, *restrain yourself*.
- Keep in mind the goal of the assignment. For example, perhaps...
  - Numerical Question: aim is correct answer.
  - Article Review: aim is familiarity with article.
  - Homework: aim is exposure to the material.
  - Report: aim is professional communication.

Specifications can be reusable maps.

Activity [Worksheet 4]

Construct a general set of specifications appropriate for answering a short answer question.

Homework: begin drafting specifications for an assignment, or assignment type, that you give in your course.

Specifications grading systems can look very different.

Example

Comparison of two implementations in mathematics.

Homework: Begin your course map.

Homework [Worksheet 5]

Group the content of your course into Bundles or Modules. Determine what assessments will represent each bundle/module. Link these bundles/modules to the course learning objectives.
Link the completion of bundles/modules to grades in the course (see Worksheet 3).

Discussion:

- State 1 thing that excites you about this potential grading system.
- State 1 thing that you still have questions about or are worried about.

Tokens are more than just get-out-of-jail free cards.

Discussion:

How might tokens be used to improve the learning experience of students?
How might you incentivize students to not use tokens?

Content is organized in modules or bundles.

Modules *are units that are sequenced during the term, and* **bundles** *are units that students can complete in any order...Which student products to include in these units of work are among the basic course design decisions an instructor makes when implementing specs grading, and they can neatly tie into learning outcomes. (page 69)*

Does it work?

Some anecdotal evidence.

- Course is built around the course objectives.
- Graded work reflects student outcomes.
- Grading is more efficient – up to 90% time savings.
- High academic standards – have to get it right.
- Students are more engaged – have to get it right.
- Students have clear and well-defined goals.
- The "adversarial" nature of the student-professor relationship is reduced.

Final thoughts...

- Remember, you define what is acceptable.
- Make use of your course learning management system.
- Do this with a buddy.
- Hold your ground; once you commit, commit.
- Take time to introduce this to students on day 1; sell it!