Grading: Policies, How-to, and Tips

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After attending this session, you should be able to:

1. Define and apply formative and summative assessment.
2. Develop rubrics that address key learning objectives.
3. Apply three survival tips into your grading workflow.

During this session, think about:

What do you think will be the most exciting aspect of grading?

What do you think will be the most challenging aspect of grading?

How will you approach overcoming the most challenging aspect?

Action items:

☐ Consider your grading timeline:
  ▪ At the start of the week, block time in your schedule for grading.
  ▪ Set realistic expectations for returning homework, exams, and reports.
  ▪ Convey your expectations to your class.

☐ Contact an Engineering Teaching Consultant (ETC) to discuss grading concerns.

Plenary Resources: tiny.cc/plenary
Concurrent Resources: tiny.cc/concurrent
Workshops/Seminars: tiny.cc/seminars

Center for Research on Learning and Teaching in Engineering
crlte.engin.umich.edu
Activity 1: Giving feedback using RISE model

Below is a sample problem with a sample grading rubric. On the back of the sheet are three student solutions to the problem. Give feedback to the three students using the RISE model (Resources packet).

As you are giving feedback, think about:

- Bloom’s revised taxonomy level of the student.
- Level of the RISE model that would elevate the student to the next level in Bloom’s Revised Taxonomy.

**WIND ENERGY (8 points)**

Given the following information, is it possible for one wind turbine (dia=15m) to produce 60kW of electric power? Explain.

Wind energy per unit mass of air = 36.1 \( \frac{J}{kg} \)

Mass flow rate through a wind turbine = 1802.5 \( \frac{kg}{s} \)

**SOLUTION WITH RUBRIC:**

Wind power

\[ P_{\text{wind}} = E \times \dot{m} \]

\[ P_{\text{wind}} = \left( 1802.5 \frac{kg}{s} \right) \left( 36.1 \frac{J}{kg} \right) \]

(0.5 points for correct equation and substitution)

\[ P_{\text{wind}} = 65.1 \text{ kW} \]

(0.5 points EACH for the correct \( P_{\text{wind}} \) value and units)

\[ \eta = \frac{\text{Total power to be generated}}{P_{\text{wind}}} \]

(0.5 point for correct efficiency equation)

\[ \eta = \frac{60 \text{ kW}}{65.1 \text{ kW}} = 92.2\% \]

(0.5 point for correct efficiency value)

The Betz limit (theoretical limit) for wind turbine efficiency is 59.3%. Hence, a single wind turbine will not be sufficient to produce 60 kW of power. Moreover, practical utility scale wind turbines achieve at most 75% of the Betz limit increasing the number of turbines needed even more.

(1 point for correct reasoning)
Student solutions

Student 1

\[ P_{\text{wind}} = E \times \dot{m} \]

\[ P_{\text{wind}} = 1802.5 \times 36.1 = 65068.87 \quad \text{(Missing units)} \]

Yes, one turbine can produce 60 kW of power. \quad \text{(Did not calculate efficiency; wrong answer)}

Student 2

\[ P_{\text{wind}} = E \times \dot{m} = \left(1802.5 \frac{\text{kg}}{s}\right) \left(36.1 \frac{\text{J}}{\text{kg}}\right) = 65.1 \text{ kW} \]

\[ \eta = \frac{\text{Total power to be generated}}{P_{\text{wind}}} = \frac{60 \text{ kW}}{65.1 \text{ kW}} = 92.2\% \]

To produce 60 kW of electric power, one turbine should have an efficiency of 92.2%, which is not achievable practically. \quad \text{(Did not address theoretical limit; even if there is a super machine to achieve the required efficiency practically, the efficiency cannot be achieved because of the theoretical limit.)}

Student 3

\[ P_{\text{wind}} = E \times \dot{m} = \left(1802.5 \frac{\text{kg}}{s}\right) \left(36.1 \frac{\text{J}}{\text{kg}}\right) = 65.1 \text{ kW} \]

\[ \eta = \frac{\text{Total power to be generated}}{P_{\text{wind}}} = \frac{60 \text{ kW}}{65.1 \text{ kW}} = 92.2\% \]

1 turbine is not sufficient to produce 60kW of electric power because the required efficiency is greater than the Betz limit. \quad \text{(Correct answer)}
Activity 2: Grading rubric (physics)

Part 1:

Below is a sample problem. Take 5 minutes to read the problem and develop a sample grading rubric for it. Decide how many point students should get for each step or lose for common mistakes.

How much antimatter would be needed to create the Baringer Meteor Crater? (10 points)

Hint: you would need to produce $6.28 \times 10^{16}$ J.

**Correct solution**

$$E = mc^2$$

Since

$$E = 6.28 \times 10^{16} \text{ J} \text{ and } c = 3.0 \times 10^8 \frac{\text{m}}{\text{s}}$$

$$m = \frac{E}{c^2} = \frac{6.28 \times 10^{16} \text{ J}}{(3.0 \times 10^8 \frac{\text{m}}{\text{s}})^2} = 0.697 \text{ kg}$$

Mass of antimatter is half of total mass: $\frac{0.697 \text{ kg}}{2} = 0.349 \text{ kg}$
Student solutions

Below are possible solutions from 7 different students. Use the rubric you just developed to assign summative grades to each student.

**Student 1:**

\[ m = \frac{E}{c^2} = \frac{6.28 \times 10^{16} \text{ J}}{\left(3.0 \times 10^{8} \frac{\text{ m}}{\text{ s}}\right)^2} = 0.697 \text{ kg} \]  
(Forgets to divide by 2)

**Student 2:**

\[ m = \frac{E}{c^2} = \frac{6.28 \times 10^{16} \text{ J}}{\left(3.0 \times 10^{8} \frac{\text{ m}}{\text{ s}}\right)^2} = 0.697 \text{ kg} \]

Mass of antimatter = \(\frac{0.697 \text{ kg}}{2}\) = \(0.349 \text{ kg}\)  
(Correct)

**Student 3:**

\[ m = \frac{E}{c^2} = \frac{6.28 \times 10^{16} \text{ J}}{\left(3.0 \times 10^{8} \frac{\text{ m}}{\text{ s}}\right)^2} = 0.532 \text{ kg} \]

Mass of antimatter = \(\frac{0.532 \text{ kg}}{2}\) = \(0.266 \text{ kg}\)  
(math error)

**Student 4:**

\(m = 0.349 \text{ kg}\)  
(doesn’t show work)

**Student 5:**

\[ m = \frac{c^2}{E} = \frac{\left(3.0 \times 10^{8} \frac{\text{ m}}{\text{ s}}\right)^2}{6.28 \times 10^{16} \text{ J}} = 1.433 \text{ kg} \]  
(Incorrect derivation)

Mass of antimatter = \(\frac{1.433 \text{ kg}}{2}\) = \(0.717 \text{ kg}\)

**Student 6:**

\[ m = \frac{E}{c^2} = \frac{6.28 \times 10^{16} \text{ J}}{\left(3.0 \times 10^{8} \frac{\text{ m}}{\text{ s}}\right)^2} = 0.697 \text{ lbs} \]

Mass of antimatter = \(\frac{0.697 \text{ kg}}{2}\) = \(0.349 \text{ lbs}\)  
(wrong units)

**Student 7:**

\[ m = \frac{E}{c^2} = \frac{6.28 \times 10^{16} \text{ J}}{\left(3.5 \times 10^{8} \frac{\text{ m}}{\text{ s}}\right)^2} = 0.697 \text{ kg} \]

Mass of antimatter = \(\frac{0.697 \text{ kg}}{2}\) = \(0.349 \text{ kg}\)  
(correct answer, mistake in middle)
Activity 3: Course policies and grading

Below is a list of some categories of course policies. How will each policy affect your grading duties?

Posting assignment solutions:

Partial credit:

Extra credit:

Makeovers/Do-overs:

Late policy:

Re-grades:

Determining final grade:

Other policies:
Things we wish we knew earlier¹

Katrina & Marcial (Winter 2010)
- Students care a lot about grades. Be fair, consistent, and try to understand where they are coming from.
- Sum the total points missed per problem / section / question and summarize on the first page (this can help reduce errors).

Nick (Fall 2009)
- Make sure the course has a grading/regrade policy at the beginning of the semester. If it doesn’t, MAKE ONE.
- Write up a set of ‘Grading Notes’ for each assignment. These ‘Notes’ are a list of common problems seen in the assignment. They should be posted with the assignment solution set, so students know how to improve their homework for the next assignment. In addition, these ‘Notes’ serve as a great journal of progress, help identify problem areas, and even become a good reference when creating test questions.

Kristen (Fall 2009)
- Grading is deceptive! Student interest, instructor interest, and the GSI/IA in between must navigate the complexities between correct and incorrect answers (emotions will run high!).
- Labs: Writing critiques and evaluating the science within (really more of an art than a science). Try to grade both Grammar and Data of the report (separately… but equally). Don’t forget to evaluate the logic that goes into linking scientific concepts in a concise and coherent way. Just listing the data is as bad as bad data

Michael (Winter 2009)
- When grading homework or an exam, grade one problem for the whole class before grading the next problem. By doing this, the chance of taking off different amounts of points for the same error is minimized. Additionally, the time needed to grade will go down because it will take less time to grade as more exams are graded.
- When grading lab reports, always provide sufficient, constructive feedback. It would help to go over the reports with the students to provide them feedback on their work. If they know the areas where they need to improve, not only will they become writers, but grading will be less time consuming in the long run.
- Be prepared. Devoting some time in advance to looking at problem sets, solving problem sets, reacquainting yourself with the curriculum will save a good deal of time with student questions and issues as the semester progresses.

¹ Excerpt from “Grading: policies, how-to, and tips resource packet”
Full text can be found online at: http://crlte.engin.umich.edu/orientation_handouts/
Survival tips for grading

- **Have a set of guidelines for turning in assignments, regrades, and grades in general.** These guidelines should be included in the syllabus given to the students on the first day of class. In general, the professor will provide these guidelines.
  - Sample guidelines could include:
    - All regrades must be turned into the GSI/IA within one week.
    - All regrades must have a written explanation of grading error.
    - Late HW not accepted.

- **Before grading, briefly skim through a portion of problems or essays.**
  - This will give a good idea of average student performance, common mistakes and misconceptions, and how to handle partial credit.

- **Be consistent with grading.**
  - To help facilitate consistency, grade one problem on each paper until all papers have been completed. It can help to practice grading with your rubric on the first several papers before grading all papers.

- **Be consistent with students**
  - What you do for one student, you must do for all students, so be careful.

- **Provide written comments (feedback) to students to explain lost points.**
  - This will save you time as it will reduce the number of students asking: “Why did I lose points on this problem?”
  - It will provide a learning tool for the students to learn from their mistakes.

- **Clearly define to the students in written directions the point values associated with each problem or part of a project.**
  - This will alleviate the “How much is this problem worth?” questions.

- **Provide students with the average and standard deviation of each assignment.**

- **Don’t take things personally.**
  - Grading issues can cause students a significant amount of anxiety. They may express anger or despair over their grade. You do not need to be a student’s buddy or enemy when it comes to grading. If you have a method for grading and regrading, stick to it and remain impartial.

- **When in doubt, involve the professor on all judgment calls, or issues where you are uncertain of the University’s accepted protocol.**
  - It is best to keep the Professor abreast of any and all grade issues that arise between you and a student.
**Bloom’s Revised Taxonomy**

The purpose of this model is to classify thinking based on six cognitive levels of complexity.

<table>
<thead>
<tr>
<th>Bloom’s Taxonomy</th>
<th>Sample Question Stems</th>
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</table>
| **Creating**     | • What would happen if ...?  
                  • Suppose you could ... what would you do ...?  
                  • How would you estimate the results for ...?  
                  • How would you test ...?  
                  • What could be done to minimize (maximize)? |
| **Evaluating**   | • Is there a better solution to ...?  
                  • What changes to ... would you recommend?  
                  • How effective are ...?  
                  • What do you think about ...?  
                  • How could you determine ...? |
| **Analyzing**    | • Why did ... changes occur?  
                  • How is ... similar to ....?  
                  • Can you distinguish between ...?  
                  • Why do you think ...?  
                  • What is the relationship between? |
| **Applying**     | • How would you use ...?  
                  • What examples can you find to ...?  
                  • What factors would you change if ...?  
                  • Would this information be useful if you had a ...?  
                  • How would you apply what you learned to develop ...? |
| **Understanding**| • Can you describe in your own words ...?  
                  • What do you think could happen next ...?  
                  • What was the main idea ...?  
                  • Can you distinguish between ...?  
                  • What differences exist between ...? |
| **Remembering**  | • What is ...?  
                  • How would you explain ...?  
                  • How would you describe ...?  
                  • Can you recall ...?  
                  • How would you show ...? |

Sample Questions and definitions adapted from the following websites:
http://www.cccs.edu/Docs/Foundation/SUN/QUESTIONS%20FOR%20THE%20REVISED%20BLOOM.doc


**Inquire**
Seek information and/or provide ideas through questioning
*EX: "Have you considered looking at X from Y perspective?" OR "When you said X, am I understanding you to mean XY?"*

**Suggest**
Introduce ideas for improvement of current iteration
*EX: “You might consider tweaking X for Y effect” OR “You might want to include supporting information from X resource - Here's a link”*

**Elevate**
Raise to a higher degree or purpose in future iterations
*EX: “Perhaps you can expand this in X capacity to further address Y” OR “Perhaps you can re-purpose X as Y for Z”*

**Reflect**
Recall, ponder and communicate
*EX: "I relate/concur/disagree with X because..." OR "I liked what you did with X because..."*