

Innovation in Delivery: Enhancing Learning through Student Empowerment

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Educational Objectives

I teach the senior-level systems class at Union College. This class is math-intensive (Laplace Transforms and differential equations) and it is difficult to maintain student enthusiasm. To make matters worse, the class is often scheduled in the afternoon teaching slot, from 3 to 4 PM. Students often look bored and dozing off in class is not uncommon. Things are especially bad in the Spring term when the contest is between differential equations and rebirth and romance that come with Spring; it just is not a fair fight.

The first objective of this innovation is to make the students more interested in class. In my teaching, I borrow heavily from the theories of social control. Forcing students to pay close attention is analogous to the Taliban forcing Afghan men to grow beards: while short term gains can be had at the expense of great stress, the strategy never works in the long term. *I believe it is the responsibility of the teacher to create a situation where the students pay close attention because they genuinely want to.* Students should not see learning engineering as a chore that needs doing; rather, they should see it as an activity that they genuinely enjoy.

The second objective of this innovation is to enhance peer-to-peer learning. I have found that students teaching each other is sometimes more effective than the traditional lecture format.

Learning Activities

I use several techniques to enhance student enthusiasm and attention in class:

First, I frequently call on students in class. I pick the student to be called using the random number generator in MATLAB. This demonstrates to the students that the person picked is not based on any instructor bias. I then pose a question to that student and demand "a good college try". However, I make it clear that they are not expected to know the answer for every question that I ask — the teacher is redundant if this is the case.

Second, about once every two weeks, I hold in-class competitions. The class is divided into groups and assigned a difficult problem to solve. The problem will frequently involve material not yet covered in lectures. The group that finishes first gets a reward that appeals to today's student — iTunes gift certificates, coupons for popular restaurants etc. On especially slow days, I up the ante by exempting the winning group from the next lab write up. This *never* fails to get them motivated. Please see "Classroom Execution" section for more details on in-class competitions.

Third, I always make it a point to track the progress of every student in the class. After grading the midterm exam, I ask for a 15 minute conference with every student to discuss their progress and potential grade in the class. When the students realize that I am committed to their learning, they respond well.

Classroom Execution

In-class competitions require careful planning and execution:

First, it is possible that one or two students in the group do all the work and others are lagging far behind. While it is acceptable for the faster students to solve the problem first, I demand that everyone in the group understands the solution completely. This enhances peer-to-peer learning. Once a group announces that they've completed the problem, I call a random group member to come to the board and explain the solution.

Second, I frequently assign problems that have multiple parts, including parts that require the use of MATLAB, Simulink, and Mathematica. No one student can hope to solve all the parts in the allotted time. This forces the students to divide the parts of the problem among themselves; this enhances teamwork.

More recently, I am attempting to harness the students' eagerness to send text messages to enhance their learning. While doing these competitions, I sequester one student from each group and I explain to them a new method of solution. The sequestered students can then communicate — but only via text messaging — to their group mates. This introduces a bit of harmless fun into the proceedings.

Formal and informal student feedback indicates that these competitions greatly enhance student understanding of difficult concepts by making learning fun.