Rewarding Excellence: Taking Away the Guaranteed 'A'

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Much has been said and written in recent years regarding grade inflation. Any discussion on that topic is beyond the scope of this paper, and most engineering faculty have already developed their own views on the matter. Opinions vary as to the significance of the rising GPAs, however the fact remains that more students are receiving grades that are higher than those given in years past. The advocate would say that teaching effectiveness and student quality have improved in recent years and the GPA rise is deserved based on merit. Other educators would offer data that does not support those claims.

The fundamental question that is most often discussed relates to the significance of awarding a grade of 'A'. Does the 'average student' of today receive a grade of 'C'? If so, why is a student with a 2.00 average (i.e. a 'C' average) on the verge of academic probation? Does the student who demonstrates competency in a given topic deserve an 'A'? They got nearly all of the answers correct on the vast majority of the graded assignments, so what grade do they deserve? What differentiates competency from mastery? If competency is rewarded with an 'A', how does one reward the truly exceptional students who demonstrate excellence in skills, effort, initiative, and creativity?

While these questions, and many others like them are valid and should be discussed in academic circles, there is no single answer that will satisfy all educators. Further, it is not the intent of this paper to attempt to provide rational argument to sway the opinions of other engineering professors. It is the intent of this paper to discuss the concept of rewarding competency and compliancy with grades less than an 'A', and discuss incentive factors developed to encourage students to strive for excellence. Specific examples will be given based on two years experience teaching a senior level course in wastewater treatment that requires a plant design project as a substantial portion of the final grade.

I have taught CE451 - Wastewater Treatment on 12 occasions over the past 9 years here at OU. It is a required senior course and has changed in scope several times over the past decade. For the past five years, the largest component of the students' final grade has been a comprehensive wastewater treatment plant design project that includes all plant operations from influent wet-well to final discharge. Students are required to complete a final report, complete plant layout and CAD drawings of individual units, and a final group oral presentation to faculty and classmates. Prior to the winter 2003 quarter, students were provided with a project statement that detailed the project expectations and the majority of students did exactly as they were told. Starting with the winter 2003 course offering, students were awarded a grade of 85% for completion of the project requirements, assuming there were no errors. In addition, they were given an opportunity to get "extra credit" for additional effort on the design project and several suggestions were offered. A copy of the project description handout is provided in Figure 1.

CE 451 - Wastewater Treatment
Winter Quarter 2003
Final Design Project

Project Requirements

1. Select or design a town with a population of approximately 50,000 to 250,000 people.
2. Describe and design any anticipated preliminary treatment. As a minimum, you must size pumps and design a bar screen.
3. Design a primary treatment system.
4. Design an activated sludge treatment system. Be sure to include a biological kinetic analysis and determine oxygen delivery requirements.
5. Design your final clarifier.
6. Design your chlorine contact basin.

All designed equipment must be accompanied by an appropriate engineering drawing.
Include all dimensions and operating specifications for all designed units.
Submit a final report as if I was a client and your team is a consulting firm bidding the project.
Completion of these project requirements with no errors will earn you a grade of 85% (B/B+).

Oral Presentations

It is anticipated that presentations will last no more than 8 minutes. This corresponds to approximately 8 slides (not including title slide) at one minute each. Be sure to include an introduction that describes your town and flows. You should have one slide with your plant layout on it. The remaining slides should cover preliminary, primary, secondary, and any tertiary treatment. Your presentation must be submitted to me by 10:00 a.m. on the day your team is scheduled to present (to give me time to load them on the computer).

Extra Credit Options

1. Design an aerated grit chamber.
2. Design a flow equalization basin.
3. Describe (or design for even more EC) sludge treatment for the WWTP.
4. Estimate and develop a materials list necessary for plant construction.
5. Estimate the cost of building the plant.
6. Develop a project timeline for construction of the plant.

Important Dates

Project due: before Friday, March 21 at 10:10 a.m.
Oral Presentations: Wednesday and Friday, March 12 & 14, in class

Figure 1. Final design project description handout for the 2003 winter quarter.

Each extra credit option was worth an additional 5% on the project grade, assuming the design was completed correctly, and no limit was given to the number of extra credit options that a team could undertake. Out of 11 project teams, consisting of 3 students per team, every team completed two of the extra credit options, options 1 and 2, and 5 teams completed a third extra credit option, option number 3. Final project grades ranged from 92 to 82, and the average of

88.4 was nearly indistinguishable from the final project average of the proceeding classes. It was clear, based on the student response, that listing extra credit criteria was equivalent to assigning it and the competent and compliant students did their expected duty by working down the list until their perceived obligations were met. Testing the hypothesis in the 2003 summer quarter, the same project description was given with identical results. There were 5 project teams, consisting of 2 students per team, and each team completed the first three extra credit options. Final project grades ranged from 92 to 83 with an average of 86.7. The project description was modified for the 2004 winter quarter and is presented in Figure 2.

CE 451 - Wastewater Treatment
Winter Quarter 2004
Final Design Project

Project Requirements

1. Select or design a town with a population of approximately 50,000 to 250,000 people.
2. Describe and design any anticipated preliminary treatment. As a minimum, you must size pumps, design a bar screen, and provide grit removal.
3. Design a primary treatment system.
4. Design an activated sludge treatment system. Be sure to include a biological kinetic analysis and determine oxygen delivery requirements.
5. Design your final clarifier.
6. Design your chlorine contact basin.

All designed equipment must be accompanied by an appropriate engineering drawing.
Include all dimensions and operating specifications for all designed units.
Submit a final report as if I was a client and your team is a consulting firm bidding the project.
Completion of these project requirements with no errors will earn you a grade of 84% (B-/B).

Oral Presentations

It is anticipated that presentations will last no more than 10 minutes. This corresponds to approximately 10 slides (not including title slide) at one minute each. Be sure to include an introduction that describes your town and flows. You should have one slide with your plant layout on it. The remaining slides should cover preliminary, primary, secondary, and any tertiary treatment. Your presentation must be submitted to me by 10:00 a.m. on the day your team is scheduled to present (to give me time to load them on the computer).

Extra Credit

You may earn your 'A' by adding components to your project. You may discuss this with me in advance to make sure your idea has point value.

Important Dates

Project due: by 2:00 p.m. on Friday, March 19
Oral Presentations: Wednesday and Friday, March 10 and 12, in class

Figure 2. Final design project description handout as of summer 2004.

The first change was that extra credit option number 1 was included in the base project. Change number two was that the base grade was lowered to an 84% and extra credit options were worth 4% each. The third and most significant change was the removal of a list of extra credit options. Students would need to approach the instructor and inquire about potential project extensions that would provide them with their extra credit points. The class discussion focused on the fact that many of the CE students were interested in areas other than the environmental field and that I would like this project to have some applicability to them. Students interested in structural engineering could design plant buildings and foundations, students interested in construction management could do materials planning and project scheduling, and the environmental engineers could still design sludge treatment units or do advanced wastewater treatment.

The most recent class to complete the course was in the summer of 2004, where 5 teams of 2 students each took the class. One group completed 4 extra credit options, one attempted 3, another attempted 2, another attempted 1, and the last group attempted none. Grades ranged from 94 to 65 with a class average on the final design project of a 79.2. The first team was excited about the project and took the opportunity to put their personality into their work. The last two groups told me that they just wanted to pass the class and graduate. When I asked them if they would have done more if I required more, all four students replied that they would, but the potential for a higher grade was not enough to motivate them to do it on their own.

A breakdown of the grades distributed for the design project as well as the final course grades is provided in Table 1. Prior to the 2004 winter quarter, 82% of students received a grade of 85% or higher on the final design project, mainly for just doing what was expected of them and no more. Further, 85% of all students received a final grade of 'B-' or better, and the collective grade point average for those students was a 3.14. Were these students competent and compliant? Yes. Did they demonstrate excellence? In most cases the answer was 'no'. Over the past year, a third of the students did not earn the 85% on the project and a similar percentage received grades less than the 'B-', and a combined grade point average of 2.81. Plus the ones who reached the top had to extend a little more effort to get the grade they were shooting for.

Let me conclude with one final philosophical question, to which I do not plan to respond. With every change in course requirements, curriculum, or life in general, a period of adjustment to the new, often higher, expectation is necessary. Then, once the new standard becomes the old standard, we raise the bar again. Where do we as engineering educators strike the balance between competency/compliancy at a current standard and excellence that sets a new standard?

Table 1. Student performance on final project and course grades after 2004 changes in final design project specifications.

Academic Years	Total # of Students	# of Project grades < 85%	% of Class	# of Final Grades < B-	% of Class
Winter 02 thru Summer 03	93	17	18%	14	15%
Winter 04 thru Summer 04	44	14	32%	15	34%