AC 2008-336: EXCELLENCE OR DISASTER? A THOUGHT EXPERIMENT ON GRADING, TEACHING AND LEARNING IN ENGINEERING SCHOOL

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Excellence or Disaster? A Thought Experiment on Grading, Teaching and Learning in Engineering School

Abstract

This paper considers the hypothesis that engineering faculty are buying popularity and avoiding responsibility in courses, with potentially disastrous consequences for engineering education. It explores the literature on grade inflation and its relationship with the misuse of student evaluations as the sole metric of teaching and learning. It considers what has changed recently in these ancient controversies, and whether these changes that cause a mutual admiration vortex of happiness, might lead to a resonant amplification of the problem with disastrous implications for U.S. engineering education in general and aerospace engineering education in particular. It considers what individual faculty might be able to do to break the strengthening vortex.

Introduction

I cannot provide quantitative proof of my hypothesis. But a story might help convey why it should be read by expert educators. On a rainy evening many years ago, a train left Pamban, the last station on mainland India before the 2km-long Pamban bridge[1] to Rameswaram Island. The wind was strong and the rain heavy, but the train had 110 passengers and five crew, many heading for the 1-hour ferry to Sri Lanka the next morning, and the railway tried to be on time. The steel bridge must have swayed in the wind, but the train got across safely, and reached the outer signal of Dhanushkodi station on the causeway – the last station before the ferry pier. The signal was red, and the train stopped. He had no quantitative data to indicate any danger where he was, but visibility was too poor and it was likely that something may have fallen across the track, so he held his position, and blew the whistle at intervals. He waited, lacking any other data. At five minutes to midnight, the tidal wave driven by the worst cyclone in 500 years rose out of the gloom and smashed the train broadside into the sea. Everyone perished. Ironically the station, a few hundred yards beyond, mostly survived. But everyone just did their jobs.

How is this important to aerospace education? I had traveled on that line many times as a child. Since the bridge was down for the next year, the pier disappeared and the ferry was found 3 miles inland, this got me my first airplane ride on the way back to Sri Lanka, and the important lesson that one should heed the flight attendant's advice to wear earplugs, because propeller noise on a DC-3 is not as benign as the rock music of a diesel locomotive. But it is also important because I have wondered why they didn't stop that train at Pamban, or why the driver did not ignore the signal and head for the station. It was probably because there was no quantitative proof of what was coming. Weather prediction and communications were not so advanced in December 1964. The storm came out of the deep Indian ocean, squeezed north between India and Sri Lanka where it reached 180mph wind speeds. In the 9-foot shallows of the Palk Strait, the storm surge became a monster tidal wave. When they finally realized how bad things were, it was far too late. Quantitative proof came much later[2].

A "C" is no longer "average"

Since the beginning of recorded history, teachers and school administrators have been wary of eroding academic standards. In the USA, a paper from the 1800s bemoaned the decline of grading standards at Harvard University[3], a complaint that still is debated at that university. From this one might conclude that the complaint is invalid. However, through 300 years, the notion that "average" performance earns a "C" grade appears to have prevailed. Recent studies indicate that this expectation has changed dramatically in the United States. Much of the data in this paper are summarized in Table 1 which serves multiple purposes. Table 1 shows that in several "elite" universities of today, upto 44% of the class gets an "A" or an "A-" and few if any get below a "C". Clearly, "average" performance now receives much better than a C. The question is whether this is earned on merit, and what are the implications if it is not.

Vast amounts of time and energy are still spent analyzing, debating and sneering about the average. Numerous peer-reviewed journal papers declare that "grade inflation" is "ubiquitous", "hypocritical", and should be reversed. However, the average keeps rising, so that one must conclude that *the majority of faculty do not agree that the average should be a "C".* I will thus dispense with that part of the debate, and focus on the "why" of grade inflation, and what aspects of this one should really worry about and attempt to rectify.

"Grade inflation" is defined for this purpose as a situation where students receive grades higher than what their levels of achievement merit. This definition is deliberately chosen to enable focus on the grades awarded to individual students, their individual levels of achievement, and the level of achievement that is appropriate for the credentials awarded. This allows me to get away from the focus on what the "average" should be.

Postulates

There is today a growing fear that our well-intentioned efforts to "improve teaching" and "emphasize good teaching in faculty evaluations" are killing off the quality controls in our curricula, even as the quality of competition from abroad is rising. The result may be a growing "perfect storm" with explosive implications for our students' ability to thrive in their careers. Very briefly, the postulates in this paper are:

1. That the Teaching Evaluation system in most American universities measures student happiness at the expense of value-addition to students as learners or future professionals.
2. That pressure on teachers to inflate grades, is high, rising, and comes from robust sources.
3. That the prognosis is grave, as ill-prepared but well-praised graduates face global competition.
4. That only the will of individual teachers can remedy this situation.

A Sampling of the Literature

The literature base on Grade Inflation is huge, and I have no aspiration nor energy to do a definite study on this subject. A Google search threw up around 1000 unique links, and exploring just a few dozen of them showed that these branched out to a multitude of in-depth references that were not included in the Google list. I do cite some links to collections and reviews, but then focus on the areas of interest to me. Lewis[4] traces the evolution of Harvard university, giving extensive references on grading. Wikipedia[5] has a page devoted to the subject. Elbogen[6]

links to numerous studies on grade inflation. Bergovec et al[7] studied grade trends at Zagreb Medical School for 1917-2003, and reported some grade inflation. This goes to show that the concern about grade inflation is not limited to engineering, or to American universities.

Seligman[8] pointed out that the real victims of grade inflation are the students who truly excel, since their performance is drowned in a sea of mediocrity that earns the same grades as they do. Seligman blamed much of grade inflation on untenured assistant professors whose insecurity about student evaluations of their performance leads to generous grading. Equally without justification, Seligman then claimed that professors were more generous in grading women and minorities, and were then driven by conscience to give high grades to everyone. This apparently fit right in with his notion (and that of the Editors of the publication) that grade inflation, like all other ills of society, had to be the result of rampant left-wing liberalism. Seligman's article shows why it is so difficult to get any sensible action to cure the real ills of grade inflation.

Manhire[9] studied academic standards at the Ohio State University. He cites "wide agreement" that student evaluations of teaching (SET) are effective metrics of teaching effectiveness, but also cites studies suggesting that SETs "foster lower standards (by way of inflated grades) and encourage faculty to dumb-down their courses for reasons pertaining to the impact of SETs on tenure, promotion in rank and salary increases" and are thus perceived to lower academic standards[10]. Manhire was left with no clear reasons for grade inflation. He speculated long the lines of Seligman, and his logic degenerated into unsupported biases rather than pursue the good leads that he had identified. His paper does include an excellent survey of the literature on the factors related to grade inflation.

Fajardo[11] surveys reports on grade inflation. Suen[12] reports on a study of grade inflation at elite American colleges and argues that grade inflation occurs because professors try to be both judge and advocate – they want their students to get good jobs, which requires good grades, even as they want them to master the subject matter. Suen reasoned that employers, like stock-buyers, would be turned off by anything less than stellar credentials. Warning and Weltzel[13] surveyed the literature on grade inflation and studied the correlation between grades and the funding mechanisms of universities. They conclude that strong upward pressure on grades exist under all forms of university funding, including public universities, as long as "funding depends on numbers of students and employers use grades as signals of productivity". Landrum and Dillinger[14] studied students' perceptions of grading, and their expectations based on those. They defined grade inflation as students receiving a grade that exceeds the level of performance in the course. They found that "average" students expected "B" or "A". They identified changes in course format, grading policies, student evaluations of instructors, and alternatives offered for extra credit and reworking of assignments as factors contributing to grade inflation.

From Kennedy[15] *"At Princeton, it was discovered that some faculty members had, over their entire careers, given "A" or "A-" course grades to as few as 35 percent of their students ("as few"?) while others awarded these grades to as many as 87 percent of their students. In some required courses, the percentage of outstanding grades varied from 22 to 67 percent.*
No wonder students quickly figure out that they can manage their grades by networking with other students and creatively adding and dropping courses so that they wind up in those taught by easy graders." This clearly brings out the "peer-pressure" aspect of grade inflation.

Wilson, B.P.[16] presents data and recommendations. He points out that average grades have risen in institutions of all types throughout higher education. He suggests that "while grade inflation is universal, Ivy League schools have elevated it to an art form", claiming that the stellar grades of their students are what they deserve. He takes the position that the purpose of grades is to provide a discriminator between students. From that position, he points out that grade inflation is a failure of educators to tell students the truth about their performance, and he quotes Harvard Professor Harvey Mansfield to say that it is the clearest sign that teachers do not take their jobs seriously, or really care about their students. Wilson cites unsuccessful efforts to curb grade inflation. Dartmouth university tried posting class average GPA on transcripts, however, the net effect was that teachers "giving" lower class averages also changed their practices, so that the overall average inflated further. Princeton has tried informing faculty of expected percentages of A grades, an approach that some at Harvard denigrated. According to Wilson, Yale refers to grade inflation as "upward grade homogenization", a term that should give pause.

Table 1: Data from published sources reporting the average Grade Point Averages at various institutions and periods

Institution	**Reported GPA in Various Periods**				
	1960s	**1970s**	**1980s**	**1990s**	**2000s**
OSU Engineering[17]					3.06
GIT					2.7
Duke U.[18]		2.7		3.3	
Lehigh		2.6		2.9	
Pacific Lutheran		2.99		3.2 (23% A)	
U. North Carolina[19]	2.38		2.75	3.0 (38% A)	
U. Washington	2.31			3.12	
Dartmouth	3.06			3.23 (44% A or A-)	
Princeton		3.08 (31%A)		3.42(43%A, 88% A/B)	
Harvard				?(46% A or A-)	

Discussion of the Issues

"Arrest the Usual Suspects!" The immortal Captain Renault of "Casablanca" comes to mind when one reads the claims by Seligman and Manhire, blaming "expanded access", "less affluent students", "minorities and women" and kind of professors whose "conscience" then forces them to hand out high grades to innocent, rich, majority, male students who of course never whine, and whose rich parents never try to bully the teacher. Basically, if non-merit considerations go into grade decisions, the process is corrupt and indefensible, so there is no need to micro-analyze the corruption further. The teacher(s) and administrative grade-fixer(s) should be fired. As my first boss told me bluntly when I asked him 3 weeks into my first (sophomore) class, what to do about an intransigent Army Major who was heading for an F, *"You gotta be objective! If you lose that, you have nothing!"* Elementary thought would also confirm experience that if there is any difference between the expectation levels of students based on affluence, then in today's generation, it is the more affluent that come with the more pampered childhoods, the experience of parental interference in school grading, and the expectation of preferential treatment in college. Thus admitting a broader spectrum of society into college should if anything do for university education what it did for Marine Corps Boot Camps – remove the pampering. If this

does not happen, it is because the school has lost sight of the standards needed for excellence, and lacks the will to be as honest as society expects it to be. The compression at the top that Manhire cites is real. Rather than an overall improvement in student performance, which should appear as a greater clustering at the average level, what we see in Table 1 is a rise in the average GPA due to a proliferation of As and A-minuses.

Comparative vs. Absolute Metric: Not everyone agrees with the nature of the problem, much less on solutions. They (and I) would remind the reader that cut-throat competition is not the main purpose of a college education. A good teacher should be able to evaluate every student's level of achievement on an absolute basis, relevant and appropriate for the times *and the outside world*. The definition of "outside world" depends on the faculty's awareness. An anecdote is in order here. In the 1970s, our institution was morphing from a teaching-dominated school to a research university that must compete at the top. We recruited the best students we could find from around the world, using quantitative metrics such as the Graduate Record Examination (which few local students took). Professors in graduate school suddenly saw several students scoring over 90% on their tests! Surely they could not compromise "standards" by giving more than 1 or 2 A grades? They tried giving "B" grades to those who got below 95%, and "C" below 90%. – but they would not give Fs to the native sons who scored in the 30s. Eventually waking up to the ludicrous situation, they gained self-confidence enough to resume grading on individual merit, and quit worrying whether this made them look "easy". Similar superstitions still exist in some European institutions, which remain happily unaware of world-class learning standards. This lesson, however, may have put us at a disadvantage to deal with today's situation.

Would you give an F to every student? Many professors (including I) very strongly believe that the only "benchmark" statistic must be a finely-tuned sense of what is reasonable, which in turn must be validated frequently and broadly against what people elsewhere achieve. Thus we see nothing conceptually wrong with a situation where every student does so well in a course which we consider to be set at an appropriate level of difficulty, that each merits an "A" (or better) by the standards that we set at the beginning of the course. There are two problems. How does one know that the expectations are at the appropriate level? Is one short-changing the students by not motivating them towards achievement beyond what they thought was possible? Would one would just as fairly award "F" grades to everyone, if none of them merited a passing grade despite all efforts to make them avoid that disaster? If the answer to this is "no", then clearly the willingness to give all "A" is quite wrong. Evidence too strong to be ignored declares that the will to grade honestly is lacking. Worse, that administrations are bowing to destructive pressures.

The Teaching Evaluation Scam

In the mid-1980s through 1990s, American engineering schools came under extreme pressure to reform engineering education. Most importantly, the Teaching Evaluation System was instituted with the help of competent experts on Education and Psychology – those who had developed the fine system in existence in the U.S. high school system and made it what is today. The promise of this system when it was sold to engineering faculty was that it was to have three components:

a) Student evaluation of teaching
b) Peer evaluation of course materials and classroom performance
c) Community recognition of contributions to advancing learning.

However, only the first of these came with easily quantified metrics. One question asked students to rate the statement "The Instructor Was an Effective Teacher" on a scale of 1 to 5. *The mean value of the score on this question was, for about 20 years, the sole metric of teaching*. Also, faculty were informed in no uncertain terms that the expected score on this question was above 4 (4.5 in more recent times) out of 5. For a teacher, there were two ways to reach this score. The first was to get many in the class to give "Strongly Agree" or "5" ratings (i.e., A+ grades for the instructor), perhaps by canvassing students, as car dealerships do after each service experience. The other, perhaps even more important, was to avoid having anyone give a "1" ("Strongly disagree"). Obviously, this meant avoiding F grades, even on homework assignments, let alone the final course grade. Although administrators swear mightily that these scores were ever given much weightage, this author can state without doubt that they have been assigned weightage to the extent of denying promotions to faculty (in recent times) based on their "inability" to get "excellent" scores, ignoring all other evidence.

Apparently this system, since it was approved by the Education Psychology Experts, is now in place in most American universities, and several foreign institutions have emulated it. The quantitative assessments conducted by experts on assessment (who have much in common with the above experts) appear to emphasize its superiority. Articles in ASEE's PRISM have praised it. However, if one looks around wondering: *"Am I the only one who thinks this is nonsense?"* one finds many pieces of evidence to the contrary. Ben Marcus confesses in TIME that as an assistant professor in the Humanities interested in getting promoted and tenured, he has learned to win good evaluations by telling poor achievers that they are indeed doing well[20]. He imagines that in engineering, things are different, that "Students … derive practical use from their courses, and they also … feel some degree of mastery when a class ends." No doubt that some of us make them feel good, but whether this sense of mastery survives the tests of the Real World is another matter.

Long[21] induces the reader to wonder whether a surgeon who takes 15 attempts to get a procedure right, can be considered to have "mastered" surgery. Long cites Lawler[22] that "with instructors not taking on the task to assess students appropriately, due to being over-worked or lazy, the path of least resistance seems to be the assigning of an A grade, or at least an inflated grade, to everyone". Long quotes Zirkel[23]: "Stripped of its rationalizations, grade inflation exists because it is simply easier for teachers to give high grades…easier on students, parents, administrators and certainly on teachers themselves. At Lake Wobegone, after all, everyone is not only above average, everyone is also happy and politically correct" (Zirkel, 1997, p.A15).

Why is there higher resistance along other routes? Doesn't faculty peer pressure make objective grading the path of least resistance? Long quotes Edwards[24]: *"Research in the area of grade inflation has led scholars to cite post-secondary administrative practices and the extensive use of student assessment of instructors as two primary causes of grade inflation on college campuses…*." Long argues that *"when job security, promotions, tenure, raises, and the like, for instructors, are relied upon so heavily by his or her students' evaluation of him or her, too much credence has been given to this source, which has led to inaccurately assessing students' academic achievements; this appears to be exposing a primary cause of the phenomenon of grade inflation in our institution of higher learning"*.

Unhappiness about the exclusive use of student evaluations in measuring teaching, is by no means restricted to engineering: it is prevalent even in colleges of education. Archibald[25] reports on a study by Greenwald and Gillmore of 600 course evaluations at U. Washington, confirming that *"Grading leniency affects ratings: .. a professor can get higher ratings by giving higher grades.. Math and science instructors suffer the worst, because they teach the roughest courses"*. Archibald points to the arbitrary standards for evaluation results. Gibson[26] conveys obvious anger, but makes three suggestions, colored no doubt, by perceptions of his environment:
"First, the instrument must include a student self-evaluation. What did you do to meet and expand your curiosity? In what ways did you seek to identify the professors strengths, and draw on them? Second, the student must also be asked to critique the social context of the class. For example: What would be the ideal number of students in this class? How many were in it? What resources do you think were made available, or unavailable? Why? What is your critique of your previous academic experience that was to have prepared you to be in this class?
I vehemently disagree with his third recommendation - about requiring students to put in their race, gender, social security number etc. Particularly in classes where students of a certain race or gender can be counted on one hand, this would be tantamount to a gag. It is far smarter to tell students that their opinion is respected, and that they should respond to an emailed (meaning name clearly shown) survey after the final grades are posted, giving frank opinions on how they learned, not how they were taught. This has worked very well, for me, as I have found in several courses since 1997, producing in-depth, thoughtful essays rather than mindless blackened circles.

Similar questions have occurred to Merrow[27]: *"What should students be learning, and what kinds of learning matter most? What kinds of teaching and student engagement promote "deep learning"? Can that learning be measured? What is the evidence?"* As I point out above, it is quite easy to find these out, by asking the students directly. How to get administrators to pay attention to these, is a question "above my pay grade" as they say at NASA.

Kanagaretnam and Thevaranjan[28] to analyze the causes and cures of grade inflation. They develop the concept of "a required level of student ratings" that is related to the leniency of a professor's grading, independent of the level of student knowledge. This is part of a mathematical framework for the arguments of Wallace and Wallace[29] (W&W) on the relationship between grade inflation and the use of student evaluations in promotion and tenure decisions. W&W *"point to the use of student evaluations in promotion and tenure decisions as the cause of grade inflation. In fact, they argue that this practice has even led to a reduction in student knowledge and manipulation in grading schemes"* and opine that costs of student evaluations have long since exceeded their value. Other analyses of the role of student evaluations in grade inflation include Refs. 30,31,32,33,34,35,36,37,38, and 39.

The prevailing "establishment wisdom" about evaluating teaching is well summarized by Tell in a interview with Shulman[40]. Some of us have difficulty seeing in that thinking, the ingredients that go into building excellent engineers, as distinct from good kindergartners. Other indicators of dissatisfaction with the use of student evaluations are seen in Hocutt[41],Pounder[42] and Crumbley[43]. Most administrators seem to readily agree that the system for evaluating teaching is deeply flawed, but there has been no significant movement towards fixing this problem, which, in an Academy that cares about teaching, should be the most basic issue of all. Or does it care?

The pressures on institutions since the mid 1990s demanded better retention at all levels, because the *national rankings weighed the retention figures heavily in the rating criteria*. Faculty in schools of Mathematics and Physics have been told very clearly that they would be fired if their class averages did not improve, and the percentage of students failing Calculus and Physics were not sharply reduced. This motivated them to force their Dean to broaden the teaching evaluation process: their College instituted peer evaluation, with faculty sitting in each others' classes and writing intelligent critiques (and praise!) about teaching materials and standards. Engineering faculty continue to be too "busy" to do this.

Do Professors Feel Pressure to Inflate Grades? Most definitely, yes, and it is certainly not confined to the rumored pressures at football schools to go even easier on the star running back. Even past the tenure track, it is no fun to see 6 out of 40 students mark "Strongly disagree" to every question on one's Teacher's Evaluation, even about "Classes started on time" – and to know that these "opinions" are weighed just as much as those of students who put thought into the evaluation. It is extremely depressing to realize that all the effort of bringing new material into the class, setting new questions that make students think, staying up late figuring out new problems, and all the care taken in grading every answer, is dissed, compared to the praise one could have won for simply teaching out of one's own ancient notes, and sitting around willing to chat all day. Some of us have simply decided to ignore the "Teaching Evaluation" and do our jobs honestly instead, though our salary raises are certainly affected adversely as "reward" for this. We do however sleep with a clear conscience.

Pizza and Free Points – For Beauty Contest Judges! Being nice has not exactly brought rewards to the Student Course Evaluation System. In the early 2000s, the system went from filling in circles on a machine-read form, to a web-based form, to spare students the pain of filling in 34 circles in each course. This labor-saving device brought the result that only about 5% or fewer of the students now bother to fill in the Evaluation. This creates interesting results. In a given course, one may hit the heights of "excellence" with a 5.0 if it is a graduate course, and only your own student bothered to fill out the evaluation – and was afraid that you would know it was s(he). Like Cinderella, one can then ride the heights for a semester as a superlative professor. More likely, though, is that only the 3 people who are heading for an F feel motivated enough to fill out the evaluation. Faced with obvious irrelevance, the Center for Excellent Teaching and Learning recommended that professors reward the class for filling out the web form. Initially the suggested reward was pizza in class, but this became irrelevant when there was nothing to be done inside the classroom. Another exhortation is to give an additional assignment grade free to every student if the class achieves an Evaluation Fill-In Rate above a specified level. Many of us, including those who have decided to ignore the "Evaluation" and such other beauty contests, remain rather skeptical about the ethics behind such moves.

Symptoms of The Ailment

Anecdotal evidence suggests that there is a problem, with employers cited as grumbling that they no longer could be sure of what they were getting when they hired a student with a given GPA. A senior professor was recently overheard telling his teaching assistant about his policy on assigning final grades (per school policy, no test, let alone the final exam, is to be graded by

anyone other than the academic faculty member): *"For the people who got less than 60 percent overall, I don't feel that I can give an A – so give them Bs.*" Most recent graduates have graduated "with honors" or better. But the most incendiary indicator of a troubling situation comes from comparing the grades given by instructors between different sections of the same course taught in the same semester, and then comparing the record of individual instructors across courses and years. Some extreme trends emerge in the data. They reflect the situation recorded by Kennedy above: *some instructors have been giving A grades to virtually everyone who signs up in their classes, regardless of the level of the course!*

To quote one senior professor: *"Nothing galls an excellent student like lax standards that result in the vast majority getting honors irrespective of their mastery of the material".* Every instructor in undergraduate engineering classes is aware that some of the students in the class are completely lost, and cannot be motivated to succeed no matter what they try. It remains sadly true that at the end of the semester, these students will not have demonstrated any competence in the subject, to justify giving them a passing grade. They are thus quite sure that when these students magically get "A" grades only in courses taught by one or two instructors, the reason is not inspired performance. This situation results in a good portion of the senior classes being unable to deal with the tests and assignments. There is a vast gulf between these students and the rest, resulting in bi-modal grade distributions. Half the class might get below C, and the rest B or above. About 20 % score below 30% on tests.

Conflict arises when the same "A" students from the "good" classes, find that they cannot pass upper-division classes where there are some absolute metrics and professors who are fair and brave enough to give F grades to 30 to 50 percent of the class. The instructor in these cases pointed with very clear evidence to the poor preparation of the students in the "pre-requisities". This raises extreme skepticism about the claims of the "good" professors. These professors, on the other hand, declare injured innocence, and point to examples of their tests and assignments. Others then point out anecdotal evidence from students, that while those tests and assignments may have looked tough, (a) the answers were posted before those were assigned, and do not change from year to year, and (b) even if one got very few of the answers right, one ended up with an A. Finally, to refute Seligman, if the "kind" graders were junior faculty, the problem would have taken less than one semester to remedy, instead of festering for decades.

Another symptom is the often abysmal performance of "star" students from the undergraduate program, when recruited into the first year of graduate school. In courses where students from overseas, or from relatively unknown institutions perform quite well, these students perform poorly. They exhibit lack of motivation and initiative, expecting too many "hints" and "detailed instructions" on assignments, rather than thinking for themselves. Table 2 lists some comments of senior aerospace engineering faculty on the problems.

The Argument For Grade Inflation: The lesson to be learned in the above environment, is that there are good, practical reasons why grade inflation is good for the professor's career. A former instructor at one of the major East Coast institutions where grade inflation has been discussed, explained the message that he got there: *"The Provost asked us to take a look at the fine buildings of the university and pointed out that every one of those was built with donations from*

alumni and their parents. He told us that if we looked forward to teaching under the trees in Winter, we could insist on reducing the class GPA. That was the end of the discussion".

Table 2: Faculty Comments on Symptoms and Contributing Factors of Poor Performance

Contributing factors		**Underlying cause?**
a. Entitlement Some students who have a high GPA believe that it is inherently unjust for them to get a bad grade in a course Some think so even if they put forth little or no effort Even some faculty members have said so much concerning otherwise good students who failed a required course For students to be given an unrealistically high appraisal of what they know is extremely dangerous!	**b. Compartmentalization of course material rather than integration** The degree program is viewed as earning points in a sporting event, with little or no connection between courses. Many sell their books after a course is finished. Instructors who "give" all the information needed on every course assignment, encourage and amplify the compartmentalization to win points on popularity.	Some of our courses are harder than others. Some students are led to believe that one gets an A with little or no effort because of their experience

"Being the Pressure-Relief Valve" Some faculty argue that there are enough courses in the curriculm that are tough, and that students face a lot of trauma as a result. Hence they feel that it is their duty to provide some relief. They do this by virtually guaranteeing that those who take their courses get "A" grades. They completely reject the notion that they are doing this for popularity, and genuinely feel that this is an unfair characterization. Some even cite religious principles of kindness. At any rate, they argue that they have Academic Freedom to grade as they wish, and it is no one else's business.

"Academic Freedom": Most faculty would react with horror to the idea of anyone laying down Target Class GPAs or other artificial statistical diktats about their teaching. They very properly cite the concept of Academic Freedom, and point out that the instructor must have total freedom to decide how to grade his/her classes. This is very noble. However, "academic freedom" does not apply where it really should – a professor doing something that is unpopular, because s(he) has decided that it is the right thing to do.

In such cases, the pressure is often very explicit. A very accomplished and internationally recognized professor who tries to do an honest job in one of our most interesting undergraduate courses, has been "hauled up" time and again, because he refuses to let people pass unless they demonstrate basic competence in arithmetic, ordinary differential equations etc. He has even been given a formal letter on why he should improve his class GPA. Another faculty member was hauled up before a student Grievance hearing simply because she refused to change an "F" given after all efforts to help the student had failed. There was absolutely no basis or evidence, but the "grievance" was allowed to go the full distance through a hearing, simply because the Administrators were too lazy to face the student or her parents. Though she was "vindicated", this traumatic experience must most definitely have damaged this professor's faith in the system.

Closing the Cycle - Great Teachers Make Great Administrators: On the other hand, universities are very generous in rewarding those who support the institution. Professors who give all (or mostly) A grades and do not cause distress to their students at any time, are vastly popular. They are thus determined to have the primary quality required of an academic administrator, as explained by The Sergeant[44]. Soon, they find themselves on 12-month contracts, with nice administrative titles. They are on the fast track to Academic Leadership. This then completes the cycle. The academic administrators of today and tomorrow are the very people who can be most generously crediting with improving America's Grade Point Average. Small chance of their insisting on anyone getting low grades – unless somehow there is money and/or advancement tied into reducing the GPA! If ever they find themselves accused of Grade Inflation, they react like Count Rostov in Tolstoy's War and Peace: *"Why – they're shooting at me! Me! Whom Everyone Loves!"*

Some Solutions

Obviously, there is small chance of reversing grade inflation, short of starting a Revolution. For those who may consider this route, it is useful to remember history. Even the most successful of Revolutions ended with the pioneering leaders, a.k.a. "troublemakers" literally losing their heads. In the event of a top administrator actually wanting and being willing to go the distance to bring back integrity into the grading and teaching evaulation processes, there are some obvious steps that might help. Wilson (Ref. 10) has already laid out several of these, very clearly. These are summarized in Table 3:

Table 3: Suggestions to reverse Grade Inflation, expanding on Wilson

Suggestions to Administrators	Suggestions to Faculty
1. Emphasize the expectations of academic preparation, maturity and responsibility, rather than "customer satisfaction" in student recruitment. [45] 2. Eliminate courses that survive only because of their low academic standards. 3. Tighten "course drop" options to reduce abuse. 4. Radically revise the Teaching Evaluation system to guard against inflationary effects 5. Focus evaluation on academic content of the course and the teacher's academic seriousness. 6. Stop wasting time on students complaining about low grades after the fact 7. Dispense academic honors to only the top 10 percent.	10. "Make a nuisance of yourself" – insist that academic standards are an essential part of the academic ethic. 11. Re-emphasize the value of grades. 12. Appeal to those with memory or ambition to join in a drive for consistency in expectations for student achievement. 13. Emphasize to students that being "tough" is essential to help them grow up quickly. Some additional suggestions from the present author: 1. Make tests out of 120, where 100 is the most that a reasonable professor can expect of the class. Reward true excellence, and defeat the hue and cry for "curving". Students who exceed your expectations, deserve to be recognized. 2. Never "give additional points" on negotiation. Always re-grade the whole paper, so that only fair requests for correction survive. 3. Amplify the value of assignments (hard work) by asking questions on the tests that only someone who put their hearts and minds into the assignment

8. Open discussion on appropriate enrollment level 9. Get rid of extracurricular programs that compete with/ subvert the academic mission of the university	can answer. Grade these in bimodal fashion. 4. Choose F rather than D, on the borderline. Think of the passengers on the aircraft your graduates may be hired to design, and of yourself walking under the flight path.

To answer the curious questions of reviewers, I expand on each of my own suggestions from above. Yes, I do choose F rather than D on the borderline. The technique of giving large, bimodal weightage to questions on the assignments, saves me from imposing meaningless Oaths on the Honor Code, and allows a simple "ask anyone, but all work you submit must be done by you" policy to encourage the most learning on homework. It also defeats micro-computations of "The Value of Time" as students consider the trauma of spending a whole 8 hours over a week ("hundreds of hours last night" as my students would say) on an assignment "worth only 2 points". It conveys that not doing your job has disproportionate consequences. Finally, it rewards those who put heart and soul into their work and sets an example for them as future bosses.

Point #2 is self-evident – it reduces the "appeals" to those which students judge to be fair, and conveys that the professor WILL correct his/her errors without hesitation. The first point is a recent experiment which appears to be successful across levels of courses. I hit upon this in desperation to silence the whiners and legal experts in a senior course, but have since used it in sophomore and graduate courses. I first set a test with one more question than I considered reasonable (yes, I do have the experience to decide what is reasonable), for a total of 110 points. Several students hit the 110, and jumped in delight to find that it was out of 100, "A" still required only 90, and that now they could "bank" some points against a future disaster. Next I pushed the limit to 115 (harder and more questions), and again some hit that. I then pushed it to 120, which no more than 1 or 2 in the class reach. Going any higher would distort the course too much and turn tests into speed-tests. Now I have a better measure of just how good my students are, and it silences those who would claim "unfairness" of the length or difficulty of the test. But the best effect is that now the students are focused on excellence. The peak of the distribution does shift towards the high grades significantly with each test, so that any requests to "curve" the final grades became laughably silly. This happened with no kindness or generosity on my part. Of course, some still failed the course, which is the sad reality of teaching, and why I continue to believe that giving "As" blindly in the name of "kindness" is an abomination. Our students can do it without any such kindness. Just give them the space to excel!

There are other opinions on the possibility of scores above 100. Dr. Long slams this practice, citing Cronin[46]: *"Bright students are clamoring for the introduction of a new grade, A++, to distinguish real merit from feel-good merit. The corrosive effect of this trend came home to me forcibly when my son announced proudly that he had (at elementary school) scored 103 on a test with a maximum (i.e., perfect) score of 100. We're launched on an inflationary spiral that insults common sense but is designed to make us feel good about ourselves".* Sorry, Dr. Long, it's reached engineering school too. My only defence is to offer anyone the opportunity to take one of the tests that I set, with the preparation, within the time and by the standards set for my students. Provided they sign a waiver of confidentiality about their score and identity.

Concluding Remarks: A Perfect Storm of Happiness?

As the extensive literature and lack of action shows, neither the problem of Grade Inflation, nor the problem of pressure to get perfect Student Evaluations, is by itself fatal. Nor is the filling of administrative posts with "excellent teachers" where excellence is measured only by student happiness ratings. Nor is the rising tide of global competition, as long as the foreigners keep looking at the US system as a reference base. But what happens when all four reinforce each other? What happens when the foreigners quit looking to the US engineering education system as exemplary, as they have stopped looking at our high schools?

Were things ever different? Yes, they were. In 1894 or 1943 or even 1964, no one seemed to worry that the engineering academy had lost its freedom and its will to stand up for academic standards. Pressure to change grades, or give good grades, would get administrators, not teachers, fired. Student evaluations of teaching made for interesting reading, and helped correct problems such as talking to the board, and they were a good check to ensure that teachers showed up, and that there weren't too many accusations of bias or abuse. For the rest, assistant professors were far more worried about being seen to be too lenient. In fact, some feared that a Teaching Award would be the Kiss of Death for tenure, painting them as less than rigorous. Deans and Presidents were accompanied by legends about their upright toughness, and strict fairness, (well, strictness, at least). The practice in our school in the 1980's was that a senior faculty member coordinated with a new teacher, with cross-grading of course sections, or having common test papers with different questions being graded by the different teachers. This was done until it was established that there was agreement on expected standards of achievements. Very importantly, teaching evaluations were not based exclusively on student happiness ratings. It was made clear to new teachers that student happiness was not the objective of teaching.

No longer. And this is what has created the conditions for nonlinear change in engineering education, or what passes for it. A strengthening Vortex of Mutual Admiration between students, faculty and administrators. One big happy family with 3.99 averages, 4.9 Teaching Evaluations, 99.99% Retention, everyone in the Top 5, and celebratory parties for administrative elevation.

What's lurking in the gathering gloom and chaos around engineering education? Should we continue to be good little faculty and wait for the Green Signal, tooting our horns and whistling into the wind from time to time? Or should we realize that we face the same utterly lonely choice as the crew of Train 671 on that fateful night Incur the passengers' wrath by refusing to cross that bridge blindly into the gloom? Or break the rules, be more afraid of the chaos and gloom around us, and more concerned about all those kids sleeping confidently under our care, than of the wrath of the Authorities?

Acknowledgements

The author acknowledges the generous assistance of several colleagues, and thanks them for taking his advice and preferring anonymity to co-authorship or other mention. No proactive article on teaching or learning would be possible without the inspiring experience of teaching students who put their heart and soul into learning, and who perhaps also tolerate the unwitting excesses foisted upon them in the name of teaching.

Bibliography

[1] "Dhanushkodi" http://en.wikipedia.org/wiki/Dhanushkodi

[2] Kulshrestha, S.M., Guptam M.G., "Satellite Study of the Rameswaram Cyclonic Storm of 20-23 December 1964. Journal of Applied Metrology, Vol. 5, June 1966, p. 373-

[3] Anon. Harvard Faculty, "Report of the Committee on Raising the Standard", Harvard University, January 16, 1894. UAIII 5.15, Harvard University Archives.

[4] Lewis, H.R., "Why Grades So Up – A Drama Without a Villain" Chapter 5 in "Excellence Without A Soul: How a Great University Forgot Education". Harvard University, 2006, 305pp. ISBN 1586483935.

[5] Anon, "Grade Inflation". Wikipedia, http://en.wikipedia.org/wiki/Grade_inflation Viewed March 2, 2008

[6] Ellbogen, J.P., "Grade Inflation: The Current Conversation". Center for Teaching and Learning, U. Wyoming, 2004. http://uwadmnweb.uwyo.edu/ctl/gradeinflation/index.asp Viewed March 2, 2008.

[7]Bergovec, M., Kuzman, T, Rojnic, M., Makovic, A**.,** "Is There Grade Inflation at Medical Schools? Case Study of the Zagreb University School of Medicine" Croatian Medical Journal, 44(1) 92-97, 2003

[8] Seligman, D., :The Grade-Inflation Swindle". Forbes magazine, March 18, 2002.

[9] Manhire, B., "The Current Status of Academic Standards in Engineering Education at Ohio State University". Proceedings of the 2002 ASEE/SEFI/TUB Colloqium, 2002.

[10] Peter Sacks [pseud.], *Generation X Goes to College: An Eye-Opening Account of Teaching In Postmodern America* (Chicago, Illinois: Carus Publishing Company, Open Court Publishing Company, 1996), passim.

[11] Fajardo, C.L., "Grade Inflation: Causes and Consequences". Am. Assoc. Behav. Sci. Online J., p. 68-75, 2004.

[12] Suen, W., in "Contact!",Newsletter, Faculty of Business & Economics, Hong Kong, Vol. 1, No. 2, Jan. 2003.

[13] Warning, S., Welzel, P., "A Note on Grade Inflation and University Competition". JEL, March 2005. warning.pdf

[14] Landrum, R.E., Dillinger, R.J., "Student perceptions of grading practices: Does "average" class performance equal a "C" grade?" Journal of Research and Development in Education, 34(1), 86-92, 2001.

[15] Kennedy, W., "Making the grade or passing the buck, part 3". TechTopics, Michigan Faculty/ Staff Newsletter, Vol. 32, No. 11, Nov. 13, 1999

[16] Wilson, B.P., "The Phenomenon of Grade Inflation in Higher Education", National Forum, 79, 4, p. 38-41, 1999

[17] Anon, "BS Graduates: GPA Statistics, Summer 2001-Spring 2002". The Ohio State University, Engineering Career Services, 2002. Viewed Jan. 18, 2008. http://career.eng.ohio-state.edu/statistics/bs-gpa2001-2002.php

[18] Wilson, B.P., "The Phenomenon of Grade Inflation in Higher Education", National Forum, 79, 4, p. 38-41, 1999, quoting Gose, B., in The Chronicle of Higher Education, 14 February 1997 and 25 July 1997

[19] Turchi, "Grade Inflation at UNC". Report of the Educational Policy Committee, 1999. Viewed Jan. 18, 2008. http://www.unc.edu/faculty/faccoun/99ARMT.htm

[20] Marcus, B., "Graded by My Students" TIME, Dec. 31, 2000.

[21] Long, J., "Is Quality Being Compromised via the Assigning of Elevated Grades?" ARC-ST Communique, Accreditation Review Committee on Education in Surgical Technology, Spring 2006.

[22] Lawler, P.A., "Grade inflation, democracy, and the ivy league". Perspectives on Pol. Science, v30, 2001 p. 133.

[23] Zirkel, P.A.," Lake Wobegone effect blamed for grade inflation at all levels". The Morning Call, Allentown, PA, p. A15. July 2, 1997.

[24] Edwards, C.H. "Grade inflation: Effects on educational quality and personal well being". *Education*, v120, i3, Spring 2000, p. 538

[25] Archibold, R.C., "Payback Time: Give Me an A or Else". New York Times, Week in Review, May 24, 1998. http://www.nytimes.com/library/review/052498students-evaluate-review.html Viewed marh 2, 2008.

[26] Gibson, R., "Toward Negotiating a Fair Process of Teaching Evaluations" Academic Policy Council (presumed of SDSU), 2004. http://www.pipeline.com/~rougeforum/TeachingEvaluationsMarch04.htm Viewed March 2, 2008.

[27] Merrow, J., "Grade Inflation: It's Not Just an Issue For the Ivy League". Teaching and Learning News, Vol. 14, No. 1, Sep-Oct. 2004, Center for Teaching Excellence, U. Maryland. p. 1, 10-11.

[28] Kanagaretnam, K., Thevaranjan, A., "Grade Inflation: Causes and Cures", Syracuse University, April 1999.

[29] Wallace J. J. and W. A. Wallace. 1998. Why the Costs of Student Evaluations Have Long Since Exceeded Their Value. Issues in Accounting Education, (1998), 443-447.
[30] Robin Wilson, "New Research Casts Doubt on Value of Student Evaluations of Professors," *The Chronicle of Higher Education*, 16 January 1998
[31] A. G. Greenwald, "Validity concerns and usefulness of student ratings," Am. Psychologist, 52, 1997, 1182-1186.
[32] A. G. Greenwald and G. M. Gillmore, "Grading leniency is a removable contaminant of student ratings," American Psychologist, 52, 1997, 1209-1217.
[33] A. G. Greenwald and G. M. Gillmore, "No pain, no gain? The importance of measuring course workload in student ratings of instruction," Journal of Educational Psychology, 89, 1997, 743-751
[34] Ted Marchese, "Student Evaluations of Teaching," Change, September/October 1997, 4.
[35] Wendy M. Williams and Stephen J. Ceci, "How'm I Doing?: Problems With Student Ratings of Instructors and Courses," Change, Sep/Oct 1997, 13-23.
[36] Anthony C. Krautmann and William Sander, "Grades and student evaluations of teachers," Economics of Education Review, 18, 1999, 59-63.
[37] Paul Trout, "Flunking the Test: The Dismal Record of Student Evaluations," Academe, Vol. 86, No. 4, July-August 2000, 58-61. URL: http://www.aaup.org/JA00Trou.htm
[38] Paul Trout, "Low Marks for Top Teachers," The Washington Post, 13 March 2000, A17. http://www.bus.lsu.edu/accounting/faculty/lcrumbley/lowmarks.html
[39] Emily Toth, "Ms. Mentor's Impeccable Advice for Women in Academia" U. Penn Press, 1997), 77-78, 94-96
[40] Tell, C., "Appreciating Good Teaching: A Conversation with Lee Shulman". Assoc for Supervision and Curriculum Development, Nat. Ed. Assoc, http://www.nea.org/teachexperience/gdtchgk.html Viewed March 2, 2008
[41] Hocutt, M.O., "De-grading student evaluations: What's wrong with student polls of teaching". Springer New York, 1987. ISSN 0895-4852 (Print) 1936-4709 (Online)
[42] Pounder, James S., "Is student evaluation of teaching worthwhile?: An analytical framework for answering the question". Quality Assurance in Education 15(2), 2007
[43] Crumbley, L., "Students' perceptions of the evaluation of college teaching". Quality Assurance in Edu 9(4), 2001.
[44] The advice is "Don't Make Waves". From the Sergeant in "No Time for Sergeants" starring Andy Griffith as Gomer Pyle.
[45] Cited from Stone, J.E., "Inflated Grades, Inflated Enrollment, and Inflated Budgets: An Analysis and Call for Review at the State Level", Education Policy Analysis Archives, Vol. 3, No. 11, June 26, 1996.
[46] Cronin, B., "For whom the bell curve tolls". Library Journal, v126, il, p. 70, January 1, 2001"