

AC 2009-515: ESTABLISHING REAL ENGAGEMENT IN LARGE MECHANICS LECTURES

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Establishing Real Engagement in Large Mechanics Lectures

Abstract

Teaching a large mechanics class poses some obvious challenges if the professor is interested in more than simply speaking in front of a class and hoping that some knowledge transmission takes place. Indeed, this aspect of traditional lecturing, one person declaiming at hopefully engaged but oftentimes bored students, is what has engendered much of the criticism heard from students and education researchers and has driven the creation of alternative teaching strategies. This paper will attempt to accomplish two objectives: discuss ways in which a traditional lecture can be made more compelling to its audience and also present approaches that will help transform the large lecture dynamic into something more akin to a seminar.

Introduction

The problems (and opportunities) facing an instructor with a large class can be illuminated by looking at the similarities (and differences) between a large lecture class and a classical Greek theatre [5], such as the one illustrated below.

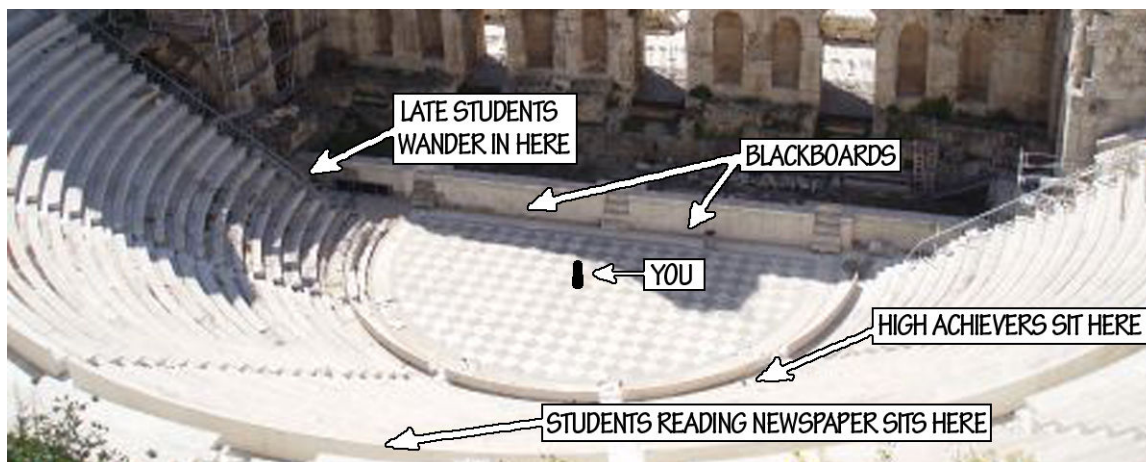


Figure 1: Greek amphitheatre/Lecture hall comparison

What is the same? In both cases we have a small group of people, in our case just the teacher and in the theatre a small troupe, speaking to a large group of people who are arranged in row upon row of seats looking down upon teacher/actor. When done well, the line between lectures and performance will, and should, become blurred [10].

Greek actors had no difficulty in engaging their listeners because they were presenting an engrossing drama or comedy and the audience was there in order to hear it. Our task is more challenging because the material often isn't inherently compelling and exciting. Their audiences came voluntarily whereas ours are compelled by graduation requirements. It's the rare student who'll voluntarily opt for Mechanics of Rigid Bodies over an episode of The Office.

Let us pause and consider this difference for just a moment more. They were presenting the equivalent of *The Office*. The audience could expect entertainment. That isn't the case for us. Or is it?

The author is firmly of the opinion that this *is* the case for us. If we approach our class in the same manner that a performer would approach his audience, we will be in a much better position to hold our student's attention and bring them into the experience. We need to provide the liveliness because the material on its own certainly won't. Rather than simply dry facts, the students benefit from context [11]. Having a coherent story from which the relevant facts emerge allow them to be better appreciated and understood.

One of our important educational goals is retention. Clearly, if the students are entertained but don't remember what they've seen or heard, our educational objectives aren't being met. By surrounding the factual material in a performance, we have actually enhanced their ability to remember. As Professor Higbee [4] documents, the human brain retains information optimally when the salient facts are contained within a memorable narrative. The instructor's job during his one hour lecture is to provide this narrative in such a way that the core material, the equations and concepts, are thereby more indelibly marked upon the students' consciousness.

As on a stage, animation and energy need to be supplied by the instructor. One needn't be a stand-up comedian to come to class with enthusiasm and a demeanor that displays interest in the material. If the instructor doesn't appear to find the material interesting, how can the student be expected to?

If we again consider a theatre environment, we'll realize that there usually are props that allow the audience to more easily comprehend the action. The same holds true for us. Abstract equations are fine but a physical demonstration packs a much greater punch. These needn't be elaborate and expensive. There's actually a charm about props that are cobbled together "on the cheap" that students appreciate. Like a hand-made Christmas present, it shows that the instructor cares enough about the class to create something "by him, for them." Props provide a dynamic visual stimulus which serves to enhance the degree to which the students are able to lay down their memories of the underlying material [8].

Also effective are pictures that illustrate some connection to the real world. A well chosen image can be presented (assuming there's a projector in the room) and talked about for a minute or two in order to reinforce the concepts and material being discussed at that moment.

These are lecturing techniques that the instructor can profitably employ. But the problem of how to alter the students' perceptions of class size remains. The key problem facing the professor who wishes to transcend this problem is the difficulty of forging an intellectual/personal bond (with a large number of students) quickly enough to initially engage them and then keeping this connection active through the quarter/semester. Engagement is one of the primary aspects of effective education [6] and is the quality that so easily springs up in seminars while remaining so difficult to initiate in large ones.

Before one can work toward creating a seminar feel in a large lecture, it is necessary to delineate how these two educational venues differ. *What makes a seminar a seminar?* The notable difference between large lectures and seminars is that in a seminar the instructor knows the students by name and they individually participate in the discussions. In a large lecture the

students are usually unknown to the instructor and the students are by and large simply passive listeners.

The author has been teaching ever larger mechanics classes over the years and as the student count has increased he has expended serious thought on this issue. Far from rejecting the lecture format, he believes that the infrastructure of traditional lecturing offers an outstanding degree of efficiency, something not to be lightly tossed aside in these times of severe budget distress. Just as Greek theatre accommodated many people at once, so too does the lecture format serve an identical purpose.

The problem is to ensure that along with being efficient, it is also effective. Through an examination of the extant literature on learning strategies, together with personal experimentation, the author has developed a multi-pronged approach that appears to do a highly effective job in answering the concerns just raised without requiring an inordinate expenditure of time to do so. This paper will delineate how this is done in a detailed enough manner that anyone wishing to try the techniques out on their own will be able to do so. The components of this “student-involved lecture class” can be listed separately but it needs to be understood that they’re actually quite tightly related to each other, each serving to reinforce the others.

Methodology

The first, and most important, element to be discussed is that of creating an interpersonal bond. The goal here is to demonstrate how the instructor can quickly learn who the students are and how to let them know that they are part of the learning process. By making a connection that, without overtly stating the fact, lets them know they’re valued as an integral part of the course, we immediately increase their buy-in to their own education.

In conventional theatre this element is missing. The audience is there simply to observe and react, not to interact. What we’re trying to do as professors is add an additional layer to this. Certainly the first element is still present, to present material that can be appreciated by the observer. But we also want to go further - to intellectually engage the listener and cause them to become part of the learning experience. When a student *wants* to come to class, it’s a great deal easier to teach him.

Getting the student to become an active part of the class means asking them to make a mental jump. What we’re asking for is the equivalent of a theatre-goer raising their hand to stop the performance in order to ask “Could you please repeat that line - I didn’t quite get it.” Or perhaps “Excuse me, but I didn’t understand that particular metaphor. Could you say it in another way?”

It sounds odd when it is put this way, certainly, but it is the reality we face in the classroom. The venue is so akin to theatre that the preconceptions of proper theatre behavior kick in, if only subliminally. It takes a brave audience member to voluntarily become part of the performance. Thus, given that it’s so difficult for a student to initiate such an interaction, the clear solution is for the professor to do so. Once the initial fear at speaking is broken down it becomes successively easier to do so.

The author has tried different approaches over the semesters and through trial and error has arrived at the solution to be presented here. The first key element is to get to know the students as quickly as possible and to let them feel that you view them as more than voiceless participants.

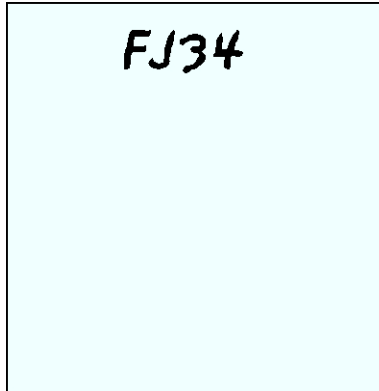


Figure 2: ID paper

All this can be begun on the first day of class and finalized in just a day or so more, with only a couple of hours of work.

1: Name/Face Acquisition

On the first day of class, you'll need to have a digital camera with you, preferably a DSLR (for speed) but any will work. The goal is to take a picture of everyone and associate their names with the appropriate picture.

Done incorrectly, this process can take an inordinate length of time. When the author first began doing so, he would have each student come up to the front and write down his name on a paper, then have his picture taken. Just a single experience with this approach was enough to show that there had to be a better way. The time to pick up the pen, write his name, and then get ready for the picture was far too long. Multiplied by the number of students in the class, it became enormous. Worse, the process of matching the picture to names was tedious and fraught with potential errors. Any mistake in the sign-up, putting a name out of order, for instance, would then mis-index all those following. Over the semesters, the author has refined his approach so that now the process requires just a few seconds per student and 100 can be accommodated in just ten minutes time.

A normal part of first-day activities is to hand out an information sheet. What the instructor needs to do is make sure that one side of the papers handed out is blank. The students are then asked to write on the blank side so as to produce something that looks like this:

They are instructed to put their first and last initials down (perhaps Francine Jerrold in our example) and the last two digits of their college student identification number. The probability that there will be two students with the same initials AND the same trailing two ID numbers is very slight. And, due to the fact that this will be associated with a picture, the probability drops even more.

The students will then be asked to walk to the front left of the classroom and stop at a marked position. Once there they hold their ID paper up at chest level. It's unfortunate that this is markedly similar to a police mug shot but we're doing it for similar reasons and thus the

procedure is somewhat similar. Unlike a mug shot, you can encourage the students to smile.

It is very helpful to have someone else present (a TA or a cooperative colleague) to direct the students row by row to the front and then back to their seats. Left to themselves, the students have a tendency to mill around, chat, go the wrong way, and so forth.

When working properly, the front of the class will look like this, viewed from an overhead vantage point:

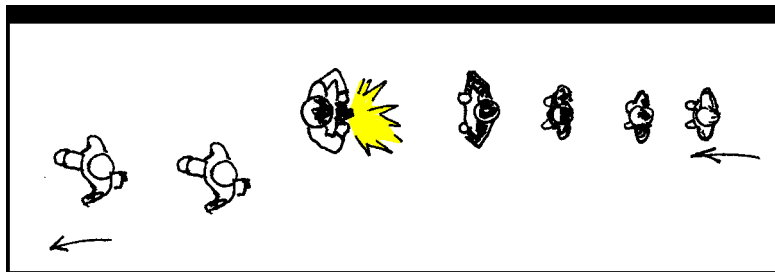


Figure 3: Picture Acquisition Assembly Line

A line of students awaiting their picture, one being photographed, and a line returning to their seats. Only a few seconds are required to snap each picture and then move on to the next person, with ten minutes enough to capture one hundred shots.

An added bonus, one which makes the whole process essentially time neutral, is that there's no need to take a role call; the pictures will provide it.

It is worth addressing a point that the author has encountered in the past - namely the issue of privacy. Some people have wondered whether students would refuse to have their pictures taken because of privacy concerns or because they want to remain anonymous. What the author can say on this point is that after having taken many hundreds of shots, he's never once received a student complaint. Quite possibly the reason for this is that it's made clear at the outset that the purpose of the pictures is purely to accelerate the process of getting to know them. Since this would happen eventually anyway, there's no good reason to object to it happening more quickly. The fact that the author doesn't ask for permission probably helps as well. He simply announces "It's picture time guys!"

Please keep in mind that it's not a completely trivial task to take "good" pictures. Good doesn't mean artistic or meaningful photos but rather ones that work for the intended purpose - namely matching an identifiable picture with a name. For instance, the student might hold the identification paper too low. Or the writing may be too light or fine to show up on the photo. Or bad focus may make it difficult to read. The following picture shows a couple of bad cases and what you want to capture. In the heat of battle (you've already taken 60 shots and are trying to get it finished) it's easy for your attention to focus on the student's face and to not concentrate on making sure that the identifying information is also in the frame. In fact, the author botched two pictures just this current semester (getting the face but no identifying information).

It is most helpful to have a DSLR with good low light sensitivity. In this case the pictures can be taken without a flash (hence more quickly). If a flash is needed, simply be sure to have enough battery power available since 100-200 shots will pose a significant battery drain.



Figure 4: Two bad pictures, one good

Once the pictures have been taken, it's time to match the name to the face. This is actually more easily done than one might expect. The author is often told he must have a photographic memory to be able to memorize the names and faces of over 100 people in a day or so, but that is simply not the case. The author's memory is in no way exceptional, in fact, it's not particularly good for most things. The ability to memorize names and faces is the product of training and technique, nothing more. And, with practice, it simply gets better.

This is the element that simply *has* to occur, at least to some reasonable level. It takes time but also not really an intellectual activity and so can be undertaken during “dead” times (walking to the car, waiting for the bus, and so forth).

To help ensure success, the exact procedure used to learn the students' names shall be gone over in detail. The first task is to download the files onto a computer. The files are too large (on the order of megabytes) at this point and have names something like IMG-2012.JPG. What's needed are compact files with useful names and so the first job is to get them into a more appropriate form.

The steps needed are

- 1: identify
- 2: crop
- 3: save/compress

One has to first open a picture file so that the image can be examined. This will let you read the ID paper and thereby enable you to identify who the student is (through use of your class list).

The next step is to crop the picture to a convenient size. What the author does is crop to a 4x3 ratio (height to width) and then resize to 400 x 300 pixels. This is large enough to yield an easily viewed image but small enough that the final file size will be quite small.

The file is then saved for the web (no preview image), which means it will only be 15 kbytes in size. A 200 person class will thus only take up 3 Mbytes of storage. The name used to save the file will be the student's name (the author uses a first name/last name ordering but last/first would also work).

Note that to speed up the process the author uses Photoshop to batch process the entire folder of files once they've been cropped and saved (but not yet resized) rather than resizing individually. If you have the software to do this it can be quite a time saver.

Please realize that the process of creating these files is itself a part of the learning phase; it is **not**

wasted time. By saving the file with the student's name you're already making an identification between the face on the screen and the name. The act of typing it out helps in the memorization process, because more of your brain is being utilized than in simply reading a name and looking at a face. The more senses that are involved in a learning process, the more effective that process is [3]. Saying the student's name out loud as you type provides an additional reinforcement.

2: Memorization

Once the named files are in a folder, they can be used in different ways. The author's approach is to first download the entire folder to his PDA. This provides a very convenient way to work on memorizing the name/face combinations during free moments in the day. The author's unit (a Palm Tungsten III) can toggle between a picture and a listing of the file names and doing so simulates flash cards. One can look at a picture and try to recall the name (toggling to check the listing as needed) or look at the list and try to visualize the face (again, toggling as needed). Eating lunch, walking to the car, taking a coffee break - these are all times that can be used to further the memorization.

There certainly exists an optimal way to proceed with the memorization, one that uses the well understood mechanisms through which the brain processes information and lays down memory. A hundred years ago Hermann Ebbinghaus coined the term "forgetting curve" to capture the rate at which acquired information is forgotten. Simply put, there is a roughly monotonic process involved with "forgetting." (The author prefers to view memory as simply a very slow form of "forgetting"). If you are told someone's name and don't make an immediate effort to remember it, the chances are that it will immediately be forgotten. And, even if you do try to remember it, there is a steady increase in the chance it will be forgotten as time marches on.

What research has been found is that the slope of this "forgetting curve" (the speed at which we become unable to recall information) becomes less steep as a function of the number of times the information is revisited [7]. By reinforcing the memory at appropriate intervals, the brain "gets the message" that it is important and keeps it active longer.

More specifically, if you look at a photo and look at the name, you'll remember that name for a few seconds. But if you look at it again, you'll be more likely to retain it for a longer time. Revisit it again a day later and the retention time rises again.

The author's memorization strategy uses this neurological behavior to maximize both the time and quality of the memorization. He starts by looking at four faces and names. Then he'll go back and repeat these four, making no overt effort at memorization yet. He will then move on to another four, repeat, and then move to another four. At this point the objective is just to get some familiarity with the faces and names, nothing more.

He will then revisit the initial four and check if any name/face combinations have stuck. The answer is usually "no." No matter. He will proceed to toggle between the face and name, repeating the name out loud, and then move on to the next.

As one might expect, it is then time to move on to the next four and then the next. Once this phase is accomplished, it's back to the first four. Perhaps surprisingly, at this point, only a minute or two into the procedure, some names are starting to stick.

This pattern of looking at a small group and then a larger group and then moving back to the small group is carried through for the entire list. Then it's time to rest and let the brain do some processing in the background. The next time the exercise is attempted there will be some successes and many non-successes in terms of identification. Repeating the process quickly fills in the holes.

This is the short term procedure. Reasonably quickly all of the names will be correlated with faces, but this accomplishment will quickly dissipate unless reinforced. For the first few days of class the author will quickly review the list, refreshing all the name/face combinations and flattening the "forgetting curve."

Another revisiting after a week and then again after a month will be all that is needed to keep the vast majority of the names and faces well remembered. A failure to do such a review will invariably lead to a loss of retention.

This approach can also be done with a computer. On Mac computers, if the photo folder is set to column view, the pictures will show up at a large magnification to the right of the listing. This is one reason that the picture was resized before saving, as experience has shown that this maximizes the displayed preview image. By using the up/down arrow keys one can quickly display a picture, glance at the name if needed, move to another, and so forth.

Another approach, if one doesn't have a PDA or computer to hand, is to print out the pictures (several to a page) and use that as a large flash card. The author used this technique recently when giving a guest lecture to a large class of graduate students. The instructor in charge had printed out a sheet of student pictures (having learned about how helpful an early ID is from prior conversations with the author) and this was all that was available ahead of time.

Interestingly, this approach has an advantage associated with it that doesn't come along with the computer/PDA method. Because the faces are arranged in a rectangular grid, it becomes a little easier to memorize names since they're arranged alphabetically. The mind will recall that a particular person's picture was to the right of a different person and, knowing that that person's last name was "Raymond," for example, reminds us that the person to his right has a last name ending in R as well. All those with "Chu" as a last name will be clustered, making it easier to memorize the group of Chu's rather than having to remember five distinct names (assuming there are five Chu's).

It has been the author's experience that even the spatial location of the faces within the grid has been helpful. Remembering that a face was near the top of the grid is a clue that the name has a low alphabetical appearance, which narrows the choices, and often there will be a memory associated with "George is the person on the far right," for example. Using the spatial part of our brains as part of the process gives us another element that works alongside the other techniques.

3: Enabling Interactivity

The first element of making the lecture seem like a seminar, that of learning student names, is over quickly; the second element, that of personal interactions, extends over the entire semester. What needs to happen is that students become accustomed to being a regular part of the discussion. Being a large class, each student won't be speaking every day but the goal is to involve each of them as many times as possible.

Several lines of attack can be used in this regard. At the start of a new lecture the author makes a point of asking someone at what point the prior lecture left off. This is a pretty easy question and provides a relatively painless way for a student to speak during class. If the student doesn't remember, then the students sitting nearby are encouraged to help him out or chime in.

The key is simply to get them to talk, to get used to hearing their own voices in the large hall so they can get over the shyness that many possess with regard to speaking during class.

When preparing to work through a derivation or bringing up a physical point is another good time to target the students. At this point you're trying to bring the student's intuition vis a vis "things mechanical" into play so they can see how they already have some worthwhile knowledge and how that might be further increased during the semester. You may be discussing rotational inertia. A good question would be "So John, do people generally like light or heavy wheels for their car?" Presumably John will have some opinion and, whatever it is, it can be used to springboard the resulting discussion.

When seminars are working well, most or all of the students will speak out and interact with each other. In an ideal seminar the students drive the discussion and the professor merely serves as a facilitator. Can something similar occur in a large lecture? Indeed it can.

What one needs to do is come up with physical problems that can be easily described and which have unexpected behavior. An example that might be used in an advanced dynamics course, for instance, would be the behavior of the rattleback. This object, when spun in a particular direction, will transition to a rocking motion and then begin to spin in the opposite direction, something that certainly confounds one's usual intuition. One approach might be to spin it in the stable direction (for which it continues to spin in the normal manner. Then the question can be posed: "What will happen if I spin it the other way." Votes can be taken in the class as to what might happen "Who thinks it'll simply continue to spin?" and so forth. Once this is accomplished, the instructor can spin it in the indicated direction and show the interesting behavior.

It is at this point that we can get the students more actively involved. They can be instructed to huddle with their neighbors, discuss it, and come to a conclusion as to why it might be occurring. They can even be asked to submit a (very) short description of what they think will happen, along with the names of the group.

The primary function is to get the students thinking and participating actively. Being part of a problem solving team necessarily increases their sense of inclusion. The limitation of the fixed seating arrangement means that these groups will necessarily be limited to nearest neighbors but that's enough to enable active discussions.

4: The BREAK

An element that truly serves to improve the course is the "break." Once again we have a parallel with the theatre, our "break" being equivalent to intermission. When the play has gone on long enough, the players are tired and the audience is getting restless, it's time for an intermission. The same applies to a lecture class.

This element can, by itself, be utilized in such a way as to enhance learning [9] but even without that aspect it serves a very useful purpose. The break is, at its simplest, exactly what it sounds

like - a break from the technical exposition. All people have a limited attention span, and that limit grows correspondingly less as the material being presented grows more abstract. Even with all the best pedagogy in the world, some of the material we as engineers present is, at least until it's mastered, quite abstract. When difficult material continues to wash upon the student, they rather quickly reach saturation. Paraphrasing of a well-known Gary Larson cartoon - "Can I leave, my brain is full?"

The way to relieve this problem is conceptually similar to the way you ease a cramp in your leg - you move it to a different position. The break moves the students' brains from mechanical engineering to something else. After about 25 minutes of discoursing, the class is paused for five minutes. As [9] discusses, the break can be used to subliminally reinforce their exposure to engineering but it needn't. It can simply be a pause - a welcome respite in which they can chat, stretch, review their notes - whatever they wish.

This break is a perfect time to accomplish two goals at once. First, it allows a student to revive his flagging interest and second, it provides an opportunity for the instructor to make personal contact. As has been mentioned previously, one of the distinguishing features of a seminar is that there is a personal connection between the professor and the small seminar group. That is a key element that, if not present, means one simply is teaching a tiny class, not a seminar.

In a large group one can't speak with every student every day but there have to be interactions with *some* students each day. The break is an ideal time to do so in a free manner. Even if the instructor doesn't do anything more than let the students free for a few minutes, he can chat with those in the front or walk up the aisles to chat with those further away.

Once again - knowing their names is key. It's not going to be helpful to say "Hey you, the girl in the hat - let's chat." But it's very easy to say "Evelyn, do you pronounce your last name Büchner or Buchner?" Evelyn's shocked realization that you know her is followed up by a sense of "he actually knows me and cares about me enough to want to know how to pronounce my name." You don't have to point this out - it occurs to her naturally. It helps to have something to say after that question as well. One could ask if she's German, or whether she's been to Germany, or any of an unlimited number of things. The key is to interact early and often.

5: Practice and Evaluation

An essential part of learning is practicing the material and an unavoidable part of our educational system is evaluation. Both presented as learning exercises that proceed continuously throughout the course, not as discrete lumps (as one or two examinations would be, for example). Homeworks and exams are clearly linked and the material discussed in lecture is linked to both as well, not just implicitly but with explicit notice given to the students so they're motivated to pay attention and thoroughly grasp the concepts.

Homework problems are consciously designed to reinforce basic mechanics concepts and enable an appreciation of how more complex problems can be attacked with a palette of simple tools. The homework problems are discussed during lecture and students are shown why the problems are important and how they're going to help their understanding. Students don't yet have the ability and insight to realize for themselves just what the homework is doing and appreciate being shown that the material isn't just make-work but serves a real educational purpose.

Tie-ins are made during lecture discussion to the real world and homework is dealt with in a similar manner. If someone knows the reason they're being asked to learn something, it becomes much easier to expend the effort to do so.

The author has eliminated the standard one or two exams during the semester and replaced them with a relatively large number of miniquizzes. One negative of a full-class period exam is the problem of makeups if a student can't come to class that day. If the student is sick, then a large proportion of his grade will be compromised. And with less than an hour for the exam, only a very few problems can be given. Even so, the number of students complaining of time pressure will remain non-zero. Although sometimes this complaint is specious (when non amount of time would help that particular student) at others it reflects the fact that some people approach problems slowly but truly do understand the material.

By eliminating such exams, these problems can be avoided. In the miniquiz format there is only a single problem and the students are told ahead of time what the area of coverage will be. Hence their studying is directed toward that area. Only a fraction of the class time is taken up with the quiz and since there's only one problem, a goodly amount of time can be allocated to it, reducing the "no time!" complaints.

Since there are many small problems over the semester, missing one becomes less of a concern. To further reduce "examination stress" the author also lets the students know that the lowest two scores will be dropped. This means that doing poorly on a quiz becomes less of a big deal. And it also means that conflicts with other commitments (job interviews, travel, etc) becomes a non-issue. If there's a conflict then that exam becomes one of the dropped ones.

At the following lecture the author will present a "Genesis of the MiniQuiz" and will show precisely how the quiz problem was taken from the lecture and/or homework. This goes a long way toward relieving the feeling students often voice that "The quiz had nothing to do with what we've been doing in class." When the connection is explicitly laid out in black and white, it becomes difficult to hold to such an opinion.

Through the particular way in which the trinity of examinations, homework and lecturing are combined, students are motivated to actually be at the discussion sections, attend the lectures and come by during office hours. They see the connections and hence see how their own performance will be enhanced by participating.

One measure of the success in driving student engagement is that attendance in the author's large classes routinely varies between 95 and 100 percent. That this occurs in a university at which a special study group has been formed to determine why attendance at lectures has declined so precipitously suggests that the approach presented herein might indeed have some merit.

Assessment

Assessment of how different approaches affect performance are always problematic, due to the difficulty of keeping everything in the course "the same" except for the tested element. Happily for this paper, the appropriate performance is whether or not the approach serves to alter the feel of the class from "a large impersonal lecture" toward "a small and personal seminar." The most valid measure for this, it being a subjective evaluation of the participants, is the feedback of those participants on their end-of-semester evaluations.

The preceding semester (when the author had a class of over 150 students), the students were given an evaluation to fill out (which is the usual procedure). The evaluation sheet contained no leading questions - it simply allowed space for personal comments, as well as asking for numerical ratings to a standard array of questions. Including all of the written responses would take up more space than is reasonable but a selection of typical ones, in the students own words (complete with misspellings), are shown.

The only potential difficulty with these excerpts is that they are rather complimentary and may come across as an immodest exhibition by the author. He hopes they will not be viewed in this manner but be viewed as simple validation that the approach delineated in this paper has merit and serve as an impetus to readers to perhaps give it a try at their institutions.

The comments are broken into two categories, Classroom Presentation and Assignments and Exams. Only those aspects relevant to this paper are included. Comments with regard to homework, computer usage, and so forth have been excluded. There actually was only one negative comment (with regard to breaks) and that is included as well.

Each comment in the Classroom Presentation has been given a tag (theater, scale, break) to show that it corresponds to a comment with regard to how well the class entertains, how well it mimics a seminar, and how breaks are viewed.

Classroom Presentation

Professor XXX always came to lecture ready and prepared. He presents the materials in a lively and interesting manner. The course material is confusing and difficult at times. The class is worthwhile because XXX makes the class enjoyable. **theatre**

Very enthusiastic about ME ZZZ, presents material in a very captivating and exciting way. **theatre**

Good at keeping class interesting and providing reasons for "why we care" about subject matter. **theatre**

Keeps students engaged. Is able to make dull subject matter interesting. **theatre**

He is, by far, the most friendly, personable professor that I've had here at Cal. He relates to students on a personal level, which is great, even though the class is very large. **scale**

I love how you knew our names. It gave this 100+ person class a homey high school feel, with extremely hard material. **scale**

Great interaction. Kinda freaky how he knows everyone's name and face, buy hey, that's a major plus. **scale**

Treats students as individuals, knows everyone's name and interacts with students to make class more personal/comfortable. **scale**

Treats students as peers. Somehow knows all of our names and interests. Is very personable. **scale**

He knows our names and where we sit! This makes me want to pay more attention in class. **scale**

Love that he knows everybody's name and makes effort to personalize conversations. **scale**

It's ridiculous that he knows everyone. **scale**

I can't believe he goes to the effort to remember everybody's name - I can't even remember what I had for breakfast. **scale**

He knows our names. What more could I say? **scale**

It's very good. I've never seen a prof. make such an effort to know his students. I'm surprised he knows my name. **scale**

Excellent and enthusiastic in presentation. Little breaks midway through class help keep class fresh (unboring). **break**

I enjoy the midlecture breaks the professor gives during. It helps with the pacing of the class in that there is no fatigue from focusing too long. **break**

Has a 5 minute picture of the day halfway through the class. I didn't like that because my time is being wasted. **break**

I like the breaks. They help me to refocus. **break**

It is so cool to learn other things during the break besides ME ZZZ stuff. **break**

I like how you took the time to commit my personal information to memory, and enlighten us with random, stimulating information and images during break. **break**

Note how prominently variations of "The professor knew everyone's name" occur in the excerpts. This is not due to cherry-picking the feedback. This kind of response has been quite a general one, over a variety of courses and semesters. A close reading of student feedback over several years has continually highlighted the importance of this one, simple item. It truly seems that achieving this simple goal - knowing their names - has a powerful resonance with students and predisposes them toward being "within" the class rather than simply viewing what happens as external observers.

Assignments and Exams

Miniquizzes are the best invention since sliced bread. It keeps me on track with the material and motivates me to not fall behind.

The miniquiz method of giving exams and testing student's knowledge is very unique and effective

miniquizzes are awesome!

miniquiz is great

The idea of miniquizzes instead of midterms is fantastic in encouraging learning and reducing stress.

Miniquizzes are less stressful than actual midterms but still keep you on top of your homework

The miniquizzes are effective and precise, yet not incredibly stressful.

I like the system of examination in this class compared in other classes.

Conclusions and Recommendations

The type of responses shown here are very much *not* present when the same course is presented in a traditional format. They clearly demonstrated that bringing a small class feel into a large lecture environment *can* be accomplished and it can be done without excessive effort.

"Without excessive effort" does not mean, however, "no effort." The instructor will need to devote some hours to the class that wouldn't otherwise be so devoted.

The results discussed here are not the result of any particular magic of the instructor. They are the product of a teaching approach that came about due to the pressure of circumstance

(increasingly large classes), can easily be implemented in a standard classroom, and, in the author's opinion, demonstrate that a high quality student learning experience can take place even in the face of large enrollments.

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