Tips for Teaching Obscenely Large Lectures

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Abstract
Teaching any class for the first time may be intimidating; but when that class is a lecture of 450 freshman engineering students, it is downright scary. Good teaching practices including the use of active and cooperative learning still apply; however, many scale with lecture size. For example, reviewing 450 “minute papers” takes considerable time, even if the students’ comments are brief. This paper will present techniques that will help you promote student learning while maintaining your sanity. We will show that despite lecture size you can still strive for assurance of student preparation for lecture, engagement of students during lecture, and creation of an overall environment conducive to learning and mutual respect. In the fall, we teach ENGR 106 - Introduction to Engineering Problem Solving and Computer Tools - to as many as 1500 students spread over only four lecture divisions. We will share the techniques we have found successful both in this class and in other large classes within our department. These techniques address student accountability and engagement while maintaining control (i.e. avoiding mob-behavior) and include: “readiness assessment tests” to ensure that students read the textbook before coming to class; active learning; undergraduate lecture teaching assistants; distribution and collection of materials as well as post-lecture review of submitted work; making the environment more friendly through music and videos; integration of learning communities; and classroom representatives and team minute papers to create a manageable student feedback mechanism. This paper will present the perspectives of a new faculty member teaching for the first time and of more experienced instructors of large classes.

Introductory Comments
One can imagine the worries of a new professor teaching for the first time: How do I write a good test? How do I keep the lectures interesting? Are my expectations of the students reasonable? What if the students don’t like me? These worries were certainly going through our minds as we each prepared to teach sections of “Engineering Problem Solving and Computer Tools” to a group of freshman engineering students for the first time. But as each of us walked into the lecture hall on the first day of our classes, our worries turned to panic - in front of us were the optimistic faces of 450 freshman engineers! What would we do if the students didn’t stop talking when we began the lecture? How could we possibly distribute 450 papers without taking up the entire class period? One student dropped a piece of paper down the steps and one of us envisioned an all-out paper airplane fight and riot. How could we possibly read 450 One-Minute Papers?

Luckily none of us were alone. With three other freshman engineering faculty, we abated these
fears with simple policies and procedures. This paper discusses the policies and procedures we have developed or adopted from others to make the most out of teaching “obscenely” large lectures. By “obscenely large” we are referring to lecture sizes on the order of 450 students; however, the tips we present in this paper may apply to lecture sizes as small as 70-100 students. We will first provide descriptions of the course, course infrastructure, and class organization, then provide tips about setting a good tone, employing active learning, and assessing student learning and teaching.

**Context - A Description of ENGR 106**

ENGR 106 - Engineering Problem Solving and Computer Tools is designed to give first-year engineering students an appreciation for what the pursuit of an engineering degree entails. The course learning objectives are such that students successfully completing the course are able to:

- Develop a logical problem solving process which includes sequential structures, conditional structures, and repetition structures for fundamental engineering problems,
- Translate a written problem statement into a mathematical model,
- Solve fundamental engineering problems using computer tools,
- Perform basic file management tasks using an appropriate computer tool,
- Work effectively and ethically as a member of a technical team, and
- Develop a work ethic appropriate for the engineering profession.

The syllabus is a coordinated mix of introduction to engineering fundamentals, including graphical representation, statistics, and economics, and introduction to computer tools used to solve engineering problems, specifically MATLAB and Excel. ENGR 106 has two 50-minute lectures and one 2-hour computer laboratory period per week. The lectures focus on fundamental engineering concepts and problem solving. The labs are organized into a series of four or five tasks that are completed either by teams of four students or individual students, as specified by the instructors. Typically, tasks walk students through the use of new computer tool syntax/procedures and simple fundamental engineering problems. Students then apply the theory learned in lecture and the syntax/procedures learned in lab to the solution of problems with engineering context.

Most students take this course in the fall semester yielding enrollments averaging 1480; an additional 400 students enroll in the course in the spring. In the fall, the students are divided among 4 lecture divisions each taught by a different instructor. To provide consistency in the content delivered in the lecture, all instructors follow the same schedule and use a common set of lecture notes. Instructors need to strike a balance between keeping pace with the other instructors and addressing the specific needs of their students. Besides lecturing, the instructors are responsible for developing common weekly laboratory and homework assignments, two semester projects, three written midterm exams, and a final lab practical. Due to the high enrollments, new assignments must be developed every semester to minimize opportunities for academic dishonesty. One faculty member, serving as a course coordinator, either writes the assignments and exams or delegates the writing, then coordinates their distribution.
The students are further broken down into 52 lab divisions taught by 18 graduate student teaching assistants and 40 undergraduate teaching assistants. Each lab is managed by one graduate and one undergraduate teaching assistant. All of the teaching assistants and the computer labs in general are managed by a Laboratory Coordinator, a professional staff member. In a large class, TAs have considerably more personal contact time with students than faculty. It is imperative that TAs understand, appreciate, and have an ability to convey the instructors teaching philosophy. This is especially true when teaching first-year students whose expectations of college courses are skewed by their high school experiences. Further, TAs are responsible for all of the grading for the course. They need to be able to grade consistently but also be flexible to different problem solving approaches. Prior to the start of each fall semester, the TAs attend a combination of Purdue University Center for Instructional Excellence TA training modules and department specific training modules.

Course Policies
High student enrollments necessitate a consistent course materials delivery system that is, for the most part, paperless. For the last four years, ENGR 106 has delivered materials using WebCT, Inc.'s course management system. This system offers a number of features that are ideal for a large course. First, minimal training is required to build and maintain a respectable looking course website. The materials we post include the course syllabus and schedule, instructor and teaching assistant contact information, assignments, and exam preparation materials such as learning objectives, formula sheets, and practice problems. Second, it provides a grade book that students can access to view their own grades with a login id; this feature is especially important with the growing concern over information privacy. We have consistently used this feature and found it invaluable to enable students to identify grade entry errors early in the semester rather than after final grades have been submitted. Third, WebCT provides private discussion boards and chat rooms that can be used to facilitate communication between the instructors and students and amongst the students themselves.

During the first laboratory of the semester, students are taught to navigate the course WebCT site. During the navigation exercise, students are directed to the syllabus. It is highly emphasized to the students that they will be held responsible for understanding and following the rules, policies, and procedures detailed in the syllabus. Over time, we've developed a thorough document to reduce instructor time spent on explaining policy to individual students and minimize opportunities for students to appeal their final grade. We include the course learning objectives, tips for being successful, the math prerequisites, an explanation of the purpose of each course element, the grading policy, class attendance policy, and the academic dishonesty and computer network policies. A number of policies listed in the syllabus are of particular importance for a class this size:

Attendance Policy: We have found that an attendance policy needs to be established. We require students to fill out an absence report and show documentation regarding the reason for their absence if they wish to make up missed work. This reduces problems with numerous students "forgetting" to come to lecture or lab and expecting alternative arrangements to be made for them and allows us to work with the students who have legitimate reasons for not attending class. It
also holds the students accountable to come to class. Professor John Gardner, Senior Fellow and Distinguished Professor Emeritus of the National Resource Center for The First-Year Experience and Students in Transition, presented during a Fall 2002 visit to Purdue perspectives on binge drinking culture on college campuses and he specifically identified the lack of required attendance as a contributing factor. When students do not feel there is something they need to go to, this allows them to feel they can participate in the binge drinking culture. Later in life, these students will be held accountable to show up to work and we are modeling that in class. It also increases the motivation of the students. If attendance is not required, attendance drops off and the students' perception of the class can be diminished.

**Grade Appeals:** A time limit needs to be set for students to appeal a posted grade. We give students 7 days to appeal a grade after it is posted on WebCT. The student is required to appeal the grade to their laboratory teaching assistant before approaching the instructor. With so many students in the course, it is easy for teaching assistants to forget the circumstances surrounding a particular grade. This policy allows us to address grade problems in a timely manner without spending huge amounts of time trying to track problems down. For instances of grading problems that cannot be resolved (e.g. a student did not follow directions and has received a justifiably low mark as a result), a list of one time "mess-ups" is maintained that are evaluated again at the end of the semester when an overall picture of the student's performance can be assessed.

**Academic Dishonesty:** There is a substantial teaming component in this course and students are encouraged to work together. This section of our syllabus attempts to define what the difference is between collaboration and academic dishonesty. The penalty for academic dishonesty is also clearly stated so that students can be referred to it when action is required.

**Assigned Seating**

Students are assigned to four-person teams in their respective laboratories. These teams are expected to work together, both performing lab tasks related to course learning objectives and developing project solutions outside of class. Nurturing the relationships between members of these lab teams is important in assuring a positive experience for all students in the course. To that end, laboratory sections are assigned seating blocks in the lecture hall, with students instructed to sit with their teammates. By seating by blocks, instructors are not burdened by assigning seats and the students have the flexibility of sitting in a configuration that best suits them. Furthermore, students are prevented from becoming isolated by always being seated with acquaintances, however forced. The direct benefit of this arrangement in the lecture is that the teams also work together on in-class active learning exercises. While these exercises are not usually extensive or time-consuming, they serve to keep the students engaged, and, properly timed, reinforce the concepts being presented by the lecturer. They also reinforce the working relationships between teammates. Seating by laboratory sections also facilitates the collection of in-class assignments during lecture (see *Active Learning*).

Assigned seating is also used for examinations. Together, the 1500 students take common exams in the university’s largest lecture hall. Students are seated by laboratory sections, but each student is assigned to a specific seat. The course instructors thus have the flexibility to separate
teammates, if desired, to reduce temptations to cheat. More importantly, in a massive common-
exam situation, students can find their seat immediately in the examination room without any
thought about who is sitting to their left or right. The efficiency this provides is appreciated by
those who schedule one exam after another in these high-demand locations as well as by the other
instructors using the same room. Instructors and graduate TAs proctor the exam, with the TAs
distributing and collecting the exams for their own sections. Again, seating the students by
section improves efficiency by reducing distribution and collection times and eliminating the need
to sort the exams by section.

**Setting and Maintaining the Tone in Lecture**

Setting the tone for the course is very important. Students typically enter large lectures expecting
to sit passively, be treated like a number, and be bored. Many students feel that large lecture
classes are something they just have to endure before they get to the smaller classes that are
“interesting”. We have found it very important to begin to create a culture and environment from
the beginning that is active and recognizes that the faculty and the students are human. How one
goes about setting the tone strongly depends on the instructor’s style and level of comfort. Each
person needs to find his/her comfort level and pick which suggestions to use.

Large lectures can feel impersonal and cold. One method to show that you are interested in
meeting and getting to know your students is to train them to properly greet you in public. Some
instructors begin by confessing that they will not be able to remember all the students, which is
obvious to a student sitting in a lecture room with more than 400 other people. In the first
lecture, a routine is repeated that goes something like this:

1. The instructor asks for a volunteer to come forward for a demonstration.
2. The instructor explains that they will simulate passing each other on the street on campus
   and asks the student to start at the other end of the room and walk toward them.
3. The student will come up and say hi and the instructor explains to the class that they now
   feel uncomfortable because they don’t have any idea who this person is. The students will
   know you, but you won’t necessarily know them. So we teach them to introduce
   themselves. We ask that they introduce themselves by telling us their name and that they
   are in our class (including the time and day if we have multiple sections).

This can be a lot of fun and get some laughs, but it is a teachable moment for the students. You
won’t remember them, but they perceive that you care about them and want to make an effort to
know them. It is amazing how much this simple little routine reduces student anxiety about
approaching you.

Being approachable also includes having students ask questions and provide input when asked. It
is not reasonable for all students to have their questions answered, but having a few students ask
questions continues to help establish that you care and can also provide you with a gauge on
where the misconceptions are. It is important that you treat all questions with respect and be
clear up front that you can not take all of the questions in class. Office hours manned by faculty
or teaching assistants are designed to help answer questions. We have also found that arranging

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to stay after class for a few minutes goes a long way. Often there are smaller rooms near the large lecture hall that you can use to see students. The students can get questions answered right after lecture and you don’t have to stress about getting out of the large room before the next class starts. We find that trying to answer questions while cleaning up after the lecture in a large classroom can be difficult, so we tell the students that we will be available in the smaller room immediately after class. This reinforces the message that we want to help them learn.

Many instructors will play music or show videos before class as the students come in. Instructors can play contemporary music, classical or a mix. Inviting students to bring CD’s is a way to invite them to actively participate and will teach you something about what they are listening to (you may even still get the occasional Beatles CD). Some instructors use music to introduce cultural diversity by selecting music from different cultures. Some begin class with a short quiz over the reading and integrate an assessment of the “CD of the Day” into the quiz. Videos that are popular with students are cartoons. Veggie Tales, SpongeBob, SquarePants or other contemporary cartoons are popular and let students know that you understand there is a lighter side. Many classrooms have technology that can display television programs and very often PBS or Nickelodeon will have cartoons playing so you don’t have to bring a video or DVD.

The instructors of ENGR 106 use class representatives to great advantage in the course. Class reps volunteer for the duration of the semester to collect in-class assignments, One-Minute Papers, surveys, and anything else that may need to be collected in the lecture setting. More importantly, these student volunteers collect feedback about the course in lab or by email from their classmates and share the feedback with the instructor. Class rep contact information is provided on the course website.

Each laboratory section has a class representative, and in some cases an alternate is also appointed. The class representatives meet as a group with the instructor on a regular basis throughout the semester, and have an "open door" if needing to present any pressing issues to the instructor between meetings. To motivate the class representatives to attend meetings, instructors meet with students briefly after lecture or, providing pizza, at night. Extra credit also serves to motivate the class reps. While it is generally hoped that specific problems will be brought to light by these meetings, general feelings about the course may also be discussed. Potential solutions may be proposed by the students or the instructor, with the discussion providing a major assist in determining how best to address problems.

In large classes especially, it is important to maintain control and attention of the students. It is very important to do this from the start. It is much easier to ease up than to have to regain control. This may seem counter to suggestions about setting a more relaxed atmosphere using music, videos and humor in class, but it is not. It is part of setting expectations. There are times when you want the students relaxed and having fun. There will be times when you want them actively discussing a problem and working together. There are other times when you want them listening quietly to what you or other students have to say. You are setting expectations for the class. It is vital if you are doing active learning that students be able to transition quickly from one mode to the other.
One of the basic first steps is to address the issue head on and directly. If students continue to talk amongst themselves, address the class. If you see a part of the class not listening, call on one of them. Early in the semester, we have found that when we have students report their results for an in-class problem or make comments, many times the other students will not listen and pay attention. Calling on students from the other side of this large lecture room and asking them to comment about the presenting students’ answers sets the expectation that they need to listen; and, if the presenting students are not speaking loudly enough, the students at large will need ask them to repeat for fear they may get called on. In extreme cases when students do not respond to direct comments and other methods, don’t be afraid to excuse the student(s) who is/are being disruptive from that class period. Typically, you only need to do this once for the students to realize you are serious. Removing a student from the classroom for reading the newspaper or talking non-stop has a memorable impact on the class. (As a note, you should become familiar with any university policies for treating disruptive students before you begin teaching.)

The issue of transition is one that can slow a class down. In a large class, once the students begin to work in teams, it is hard to get them back to a traditional lecture mode. Rather than yelling at the students to get their attention, one technique advocated by the Foundation Coalition is to train them to raise both hands (making a touchdown sign) when they see you raise your hands. Once the students are taught the technique, it can significantly shorten the time it takes to bring students back to a mode where they need to be listening.

The last aspect of setting the tone is to help students realize that mistakes will be made: by you and by them. You want the students to take chances and push themselves and the results will be periodic mistakes. It is also likely that at some time during the semester you will make some kind of mistake in front of many hundreds of eyes. Few things can freeze an instructor as quickly, but remember that you are modeling how to handle mistakes. Admit them. We have all left class and had someone point out, after the fact, that we had made some kind of error. Admit it to the class, use it as a teachable moment, and move on. You are a role model to the students, but you don’t have to be perfect.

Bottom line - students need to attend lecture for you to make a connection and set the tone. Students need to not only attend, they need to come prepared to learn. Attendance is monitored in our classes through assignments and quizzes that are done in class. (For a more thorough discussion of attendance procedures, see Active Learning.)

**Setting and Maintaining the Tone Outside of Lecture**

There is also a balance to setting the tone. While we want the students to enjoy their experience, we expect them to work hard. We all want our students to feel comfortable in class and able to learn, but it is also important that students feel a sense of responsibility for their own learning. The instructional team for ENGR 106 posts a set of expectations for the students on WebCT. The list for the Fall 2002 semester included:

- Treat fellow students and the members of the instructional team with respect.
- Abide by the honor code and act in an ethical manner.
• Come to lecture and lab on time.
• Come to lab with the homework completed. This means printed out, stapled, and ready to turn in immediately upon entering the laboratory if a hard copy submission is required.
• Bring the appropriate materials to lecture and lab (e.g. textbooks).
• Come to lab having read the reading assignment.
• Work with your team in lab and lecture as specified by the instructional team.
• Be responsible for Learning Objectives not explicitly covered in lecture.
• Check your grades weekly and report discrepancies to the TA within the seven-day time frame.
• Bring the appropriate materials to lecture and lab (e.g. textbooks).
• Come to lab having read the reading assignment.
• Work with your team in lab and lecture as specified by the instructional team.
• Be responsible for Learning Objectives not explicitly covered in lecture.
• Check your grades weekly and report discrepancies to the TA within the seven-day time frame.

To establish that the instructional team will work hard with them, we also post expectations for the faculty:

• Regard each student's welfare with care.
• Endeavor to make the course interesting and worthwhile.
• Relate course material to engineering applications.
• Be prepared to start lecture on time.
• Come to lecture prepared and organized.
• End lecture on time.
• Stay after lecture (when possible) to answer questions.
• Keep apprised of what is occurring in the laboratories.
• Promote positive interdependence of student teams.
• Promote positive interdependence of the instructional team.
• Keep apprised of what is occurring in the course in general with the aid of the Class Representatives.
• Work all labs and homework assignments.
• Maintain scheduled office hours.
• Respond to student e-mail in a timely fashion.

Similarly, we post expectation of the teaching assistants who facilitate the labs:

• Make providing a high quality student-instructor interaction a priority.
• Promote positive interdependence of student teams.
• Arrive in the laboratory 10 minutes before your sections or office hours start.
• Start lab on time.
• Come to lab having done the lab and the follow-up homework yourself.
• Always indicate the reason for deduction of points on all student work. If necessary, use a grade form with each assignment.
• Collect assignments at the start of each laboratory.
• Accept no work for unexcused absences.
• Enable students with excused absences to complete the missed work in the time frame established by the Professor or Lab Coordinator.
• Return all assignments within one week and post grades immediately.
• Be sure that students collect their work, even if you physically have to hand them back their work.
• Expect and accept alternative ways of solving problems.
• Respond to student e-mail in a timely fashion.

We want the students to understand that we want them to succeed. In addition to the expectations, we also post a list of tips for success in the course. These tips include:

• **Take ownership of your education and learning process.** Successful problem solvers have to practice and learn material on their own.
• **Remember that you are beginning to learn a new language - the language of engineering.** Most freshman engineering students do not have a background in engineering. So when problems are placed in an engineering context that uses the language of engineering, as will occur in ENGR 106, you may find some problems difficult to understand at first glance.
• **Be an active participant in classroom activities.** The more engaged you are in the classroom, the more you will get out of the class.
• **Come prepared for class.** By doing the reading assignments before class, you will understand more of the content covered in class.
• **Learn to be accountable to your team** and have your team be accountable to you to complete assignments and learn the course material. You will be working in a team of four in lab, in lecture, and on projects. You will need to be an active participant on the team.
• **Meet your team outside of class to complete assignments.** Projects and some homework assignments will require that your team meet outside of class.
• **Rely on your peers as well as the faculty and staff to learn the course material.** You peers are a great resource! On the flip side, your peers may come to you for help. By helping your peers learn the material, you will gain greater understanding of the course material. Do not be reluctant to contact any member of the ENGR 106 Instructional Team when you need help. All faculty have regularly scheduled office hours, and there are even office hours manned by the teaching assistants.
• **Be aware that you will solve problems for which there are no unique solutions.** Due to this fact, you may get many different responses when you seek help on a problem because there are many different ways to solve the problem.
• **Expect to spend more time per credit hour on this class compared to your other classes** depending on your prior knowledge, experiences, and study habits. The content of this course and the skills we wish you to develop are very different from high school courses. Therefore, some ENGR 106 assignments may take longer than your math and chemistry assignments.

We also try to pop into the lab sections so that we can see how things are going and the students
see us in the labs. This has helped visibility and it also gives us a feel for where the students’ misconceptions are. In our course, there are two team projects as part of the course. TAs staff evening office hours but faculty members attend these hours in the weeks prior to the projects. While many of the students find the projects difficult, they comment that seeing the faculty in the labs late into the evening makes it hard for them to complain. They are working hard and feel we are doing so also. This is also a great time to engage the students. It is surprising how many discussions occur in this environment about many topics, involving the course, engineering and life in general.

Students perform peer and self evaluations midway through each project as well as at the end of each project. These evaluations serve as both formative and summative assessments: they are used to adjust grades for individual team members as well as to assess how teams are functioning. Those students who report having problems meet in their teams with the instructor for help with group functioning. Such team facilitations are another mechanism by which faculty interact with students outside of class.

Finally, in setting the tone that we do care about them, we arrange for ways for students to see us and interact with us outside of class. Some faculty are faculty fellows in the residence halls and go to dinner with students once a week. Some have office hours in the residence halls over lunch. Others are involved in co-curricular activities through freshman learning communities. These activities allow the students to obtain more contact with you and see you in action. We try to set the tone that we are approachable and care about the students.

**Active Learning**

Large lectures do not have to be passive learning environments. Study after study has shown how active learning improves the retention and comprehension of classroom material. Active learning can be done in a large lecture; implementation issues relate mostly to logistics. Similar techniques can be used for large lectures as smaller lectures, you just need to be prepared and need resources. For the lectures of about 450, we have undergraduate assistants that come to lecture to help with in-class exercises. Having enough people to answer questions during active exercises is important. The numbers of people you need depends upon the activities you are engaged in and the number of students teams in the class. During the activities, the teaching assistants “work the room” and you should also. This is especially true about the back of the classroom. In large lectures, you are far from these students and they don’t get a chance to see you up close. If you wear a microphone in class, remember to turn it off when you walk around the room and talk to individual students or the class gets confused.

The undergraduate assistants can also grade the results of the in class activities which provides a level of accountability to the work. In-class activities can take the form of short exercises that are completed individually, in pairs, or in the assigned lab teams. Not all exercises are graded. For those that are collected and graded, attendance grades are issued based on either attendance only (full credit if the student came to class), standard quiz-style grading, or a hybrid of half attendance and half reasonable results. We have found it important to use a mix of these methods. If the students are always using teams, they may feel like they do not have to come prepared. If they
are only graded on attendance, they do not take the exercises as seriously.

One type of individual quiz is the RAT, Ready Assessment Test. These short quizzes are based on the reading assignments for that class period. The RAT’s are a short list of simple questions that the student would find easy to answer if he/she did the reading.

We have found that seating the students in their lab groups with the class representatives collecting the in class assignments is a good way to handle the logistics of collection. It takes a few lectures to get the students used to where to sit, but then it works very well. At the start of each class that involves an in class activity, the lab representatives pick up a large envelope marked with their lab section. At the end of the class, they return it with the assignments for their lab ready for the teaching assistants to grade. Students are required to turn in their papers to the correct envelope; therefore, they make sure they sit in their sections.

One need not collect the in class assignments to get feedback on how students are performing on them. We can ask students for a show of hands for the right answer, or use methods which protect their anonymity. Often, students feel intimidated showing their peers their answers if they are not confident that they are correct. One lecture room we use has an electronic student response system which allows students to input numbers or letters for answers. These responses can be displayed for the class in aggregate form so the class can see which answers are the most popular. This allows the instructor to give a short “quiz” that has a multiple choice set of answers and to get instant feedback on where the students are in their understanding. The advantage to this is that we get feedback instantly during lecture rather than waiting for the assignments to be graded.

In a lecture room without this technology, you can give the students colored index cards and have the answers correspond to different colors. If you are concerned that the students may feel inhibited showing the whole class their answers, you can use a technique where students trade answers. Distribute blank index cards to all students and have them write answers to a set of questions but not to include their name. Have the students stand up and trade their card with a neighbor (one exchange) and then with another person (two exchanges) and another (three exchanges) and then sit back down. Three exchanges of cards with different people insures that they do not know whose card they have. Then have the students stand or raise their hand to show the answers on the card they are holding. This way no one knows what any one person's answers were but you as an instructor can get a feel for how the class is doing as a whole.

**Assessment**

Whether this is your first or tenth time teaching the class, you need to keep your “thumb on the pulse” of the class. Student self assessment of their learning takes place in several ways, with feedback being from individuals, teams, or both. Each lecture experience may be assessed by collecting One-Minute Papers from the students. In most cases, the One-Minute Papers collected request the students to indicate both the clearest and the most confusing concept from the lecture just completed. Summaries may be compiled by the instructor, by teaching assistants, or by the class representatives. These summaries generally provide valuable guidance for the direction of
the next lecture by assessing the learning that has taken place on the various topics presented.

Very often, the first time this is done, there are many remarks that are not as helpful as you would like. The class needs to be “trained” to provide useful feedback. This is done by putting together lists of comments that represent student responses from their One Minute Papers. One list can be titled, “Helpful Comments”. These comments are indicative of the comments you find useful and want to encourage. Another list can be titled “Less Helpful Comments”. For example, there are almost always comments that go something like “everything is confusing”. If the students hear that you actually look at them and want concrete examples to help improve their learning environment, they will provide better comments. One or two “trainings” is usually sufficient to improve the quality of the comments.

When an examination is imminent, One-Minute Papers are also employed to identify those topics students wish to have reviewed. A summary of these submissions, ranked by frequency, provides the instructor with a guide to the needed topics of review coverage. We have found it effective to have the class representatives summarize the topics most commonly requested for their divisions. One quick meeting with the class representatives after class can set the review topics very quickly and address the major topics requested by the class. The individual topics can still be given to the instructor for further review.

The class representatives also provide valuable assessment information, both for individual lecture coverage and exam preparedness. Feedback mechanisms include email and the brief after-class discussions and nightly meetings discussed earlier.

These assessment tools may be used in the other direction: while assessing student learning, instructors may also assess their teaching. One item commonly used on the One-Minute Papers is "Comments for the good of the course" or some equivalent. This gives students frequent opportunity to communicate their perception of the quality of the instructional effort, including the lecture. These comments may be supplemented by a mid-term course and instructor evaluation. This evaluation needn't be a full-blown formal evaluation like the one commonly performed at the end of the semester. Something slightly more sophisticated than the One-Minute Paper (a "Three-Minute Paper", perhaps?) will suffice. With these evaluations, student concerns and suggestions may be fully considered for the general betterment of the course.

Providing more guided questions for the mid-semester evaluation is recommended; and generally, two questions are sufficient:

1. What do you like about this course?
2. What specific suggestions do you have for changing this course?

The first question gets students thinking about positive aspects of the course, surely there are some. The second question does not ask what they don’t like, but rather asks them for actions that could change the course for the better. These have been effective in guiding student comments. We also ask for the responses to be done as a team and for the responses to be a consensus of the team. This helps to filter out individual complaints or ideas that are not as
widespread. If a team of four feels some change is worth considering, then it probably deserves consideration.

Finally, students will not persist in their cooperation in carrying out these assessments if they do not perceive that the instructor will read, address, or act on their comments. If a suggestion is made by a substantial number of students, it needs to be acknowledged. When no action can be taken on such a suggestion, the students deserve at the very least to be informed why no action is possible. When changes are possible, they should be made, and the students so informed. A "thank-you" for the suggestion is a touch they all appreciate.

Concluding Remarks
Managing a class of 1500 students, or lecturing to a group of 400, is not easy. The authors of this paper do not advocate the use of large lectures – certainly we believe a smaller environment helps promote learning while allowing the instructor to get to know each student. However, should you be required to teach a large lecture, we hope these tips will help reduce your frustration and anxiety and make the overall experience a good one. Even in classes that have several hundred students, you can get student comments at the end of the semester that “Professor (X) really cared about the class and gave us personal attention.”

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References

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