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Strategies for Teaching Large Undergraduate Classes

In this report, Hanover Research explores common strategies and guidelines used by universities to best teach high-enrollment undergraduate classes, including an outline of the many new technologies that are increasingly being used to teach these classes in the United States and around the world. Included are profiles of how these strategies are put forth at specific institutions of higher learning.

Introduction

Undergraduate classes with high enrollments can be some of the most difficult classes for professors to teach. This report outlines the methods that professors in the United States, Australia, Canada, and the United Kingdom use to overcome the difficulties inherent in teaching these classes and create effective learning environments. These methods include using both simple teaching and organizational strategies and a variety of new technologies to enhance the learning environment.

Large undergraduate classes are most often taught by an instructor lecturing to a sizeable group of students, creating a situation that can sometimes be inefficient and unrewarding for both students and instructors.[1] The difficulties in these classes have remained the same for decades. An article in *Educause Quarterly*, a journal dedicated to exploring how technology can best be implemented in the classroom, explained how the major problems have stayed the same as those noted in 1986 by Maryellen Gleason:[2]

- **Large space.** Large lectures take place in a big room, and interaction doesn't feel like personal communication because the instructor is so far away. Tight rows make group discussion difficult.
- **Isolation.** Large lectures are full of people, mostly strangers, creating a sense for students that what they say and do doesn't matter, leading them to care less about seemingly small distractions (like talking to a neighbor or reading a newspaper), and creating an inhibition about participating in front of a large audience.
- **Group size.** The sheer number of students makes discussion during a regular lecture that includes everyone (or everyone willing to chime in) impossible.
- **Sage on the stage.** The instructor appears impersonal, remote, and inaccessible, and the communication gap between the students and the instructor feels (and may be) very real.
- **Theater setting.** A seating arrangement t hat feels more like a theater than a class induces student passivity.

The main goals for professors teaching large classes are to make the class seem smaller than it is, encourage students to participate, and makes themselves accessible to the students.[3] Essentially, professors must change what is naturally a passive learning environment, where the professors lecture at the students, into a place where

[1] Center for Teaching Excellence, University of Maryland. 2008. "Large Classes: A Teaching Guide: Personalizing the Large Class." http://www.cte.umd.edu/library/teachingLargeClass/guide/ch4.html
[2] Aagard, H., Bowen,K., and Olesova, L. 2010. "Hotseat: Opening the Backchannel in Large Lectures." Educause Quarterly, 33: 3. http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/HotseatOpeningtheBackchannelin/213668
[3] University of Maryland, "Large Classes: A Teaching Guide." Op. cit.

students can practice active learning and become individually engaged in the class.[4] In classes with large enrollments it is important to foster student-faculty interaction to create an environment where professors are accessible and students feel comfortable contacting them. To achieve these goals professors use a variety of organizational and teaching methods. Recently, more and more institutions have been adopting various new technologies to further improve the teaching of large undergraduate classes.

Section 1 of this report explains the non-technological organizational and teaching strategies that professors can use to best teach large lecture classes. Outlined are common methods and guidelines for creating a productive and organized classroom environment, promoting student-faculty interaction, and fostering active learning.

Section 2 outlines new technologies that universities can adopt to help facilitate better learning environments in large undergraduate classes. These new technologies generally fall into two categories: those that enhance the in-class experience and those that create electronic tools and forums for students and faculty to use outside of class. This section both discusses how universities have used different technologies to serve these purposes and what sorts of results they have seen.

Key Findings

This report was conducted through an extensive online scan of the secondary literature on how large undergraduate classes are taught at higher education institutions in the United States, Australia, Canada, and the United Kingdom. Detailed below are the key findings on what strategies institutions commonly employ in teaching these classes:

Organization

Prepare the class with a clear structure and set of expectations and communicate those to the students: This will create a situation where the instructor is prepared to teach and the students know what to expect, both in terms of material covered and course expectations.

- **Carefully plan assessments:** Assessments should be planned with a realistic understanding of the administrative difficulties in grading for a large class. Ideally, assessment should be spread evenly over the course of a semester.

[4] Allen, D. and Tanner, K. 2005. "Infusing Active Learning into the Large-enrollment Biology Class: Seven Strategies, from the Simple to Complex." *Cell Biology Education,* 4:4, 262. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1305885/

Teaching Strategies

- **Create ways for students to actively engage with the course material:** A variety of techniques, such as using class discussion and group activities, can help facilitate active learning.
- **Foster student-faculty interaction:** Simply finding ways to interact with students can help them engage with the course.
- **Create opportunities for students to meet in smaller groups outside of the lecture hall:** Dividing a large class into smaller groups can help students learn the material in a more collaborative and active fashion than they would if they just sat in a lecture hall.

Using Technology in the Classroom

- **Use technology to give lectures:** Using visual aids, such as PowerPoint presentations, videos, and images from the Internet, can help break up a lecture and hold students' attention.
- **Use Audience Response Systems:** Audience response systems, including clickers and programs students can download, create an environment where more students are able and willing to participate in class, thereby encouraging active learning.

Using Technology out of the Classroom

- **Create Electronic Forums:** Using a variety of online social-networking sites, like Facebook, Twitter, and Wetpaint, and sites that have specifically been designed for education, like Blackboard and Hotseat, can help facilitate student discussion and engagement with course material.
- **Share and manage information online:** Sharing and managing information online - such as lectures, homework, tests and quizzes - can help students better prepare for class, and can help professors better organize class materials and track student performance.

Organizational and Teaching Strategies

Large lecture classes have been a standard feature of universities in the United States and around the world for a long time. Accordingly, instructors have developed a number of common strategies to best organize and teach these classes. These strategies are often designed to make class periods productive and efficient, foster student-faculty interaction, or create an active-learning environment.

While in smaller classes it is possible to make sudden changes to the course plan, in a large-enrollment undergraduate class it is especially important to firmly and clearly organize the course before the first day of class.[5] The University of California-Berkeley provides a number of guidelines for instructors on how large classes should be organized:[6]

- Decide what content to cover and set broad goals well in advance. Make sure to make estimates for how long it will take to cover material and then increase estimates by 50 percent to allow for students to ask questions.
- Organize the topics in a sequence that makes sense both to the instructor and the students.
- Describe how the course is organized in the syllabus.
- Prepare different types of lectures to suit the content and keep the students interested. For example, one day conduct a simple expository lecture that describes a topic with hierarchical minor and major points and the next day provide a case study lecture that examines one case study to examine specific topics.
- Create a clear syllabus with both the course structure and the expectations of the students.
- Meet with teaching assistants before the class starts to discuss the course structure and the expectations placed on them.

These are just some suggestions for organizational strategies that help create a situation where the instructor is prepared to teach and the students know what to expect, both in terms of material covered and course expectations.

Another key area in the organization of large undergraduate classes is strategically planning assessments. Obviously in large classes it can be difficult to grade so many assignments, so it is necessary to spend time developing means of assessment that are feasible for a large group of students. One way to do so is by using a combination of easy-to-grade multiple choice assignments to assess basic knowledge and more labor intensive projects like essays to assess higher learning goals. Ideally, these

[5] Gross Davis, B. 1993. "Tools for Teaching." Jossey-Bass Publishers: San Francisco. http://teaching.berkeley.edu/bgd/largelecture.html
[6] Ibid.

assessments could be spread evenly over the course of a semester to avoid an overload of assignments to grade at the end.[7]

In addition to clear and comprehensive course organization, fostering student-faculty interaction is another simple, but important, strategy for teaching large classes. According to the University of Maryland Center for Teaching Excellence, "in any class, but especially in large classes, it is important to establish an atmosphere which conveys the professor's interest in and accessibility to students and which encourages students to participate."[8] In order to create this atmosphere where students are comfortable with professors and are encouraged to participate, professors can use any number of simple means to connect with the students. The George Washington University's Center for Innovative Teaching and Learning suggests some basic ways to facilitate student-faculty interactions:[9]

- Spend some time at the end of class talking to students. Maybe even end class a few minutes early so there is enough time for students to come and ask individual questions.
- Make an effort to call students by their names. Because it can be difficult to remember the names of everybody in a large, have students place placards with their names on their desks.
- Walk around during class to make the students feel more connected.
- Have the students fill out a "student profile" on the first day detailing their personal interests.
- Frequently remind students that they are always more than welcome to come to office hours.

These methods serve the purpose of turning large classes into social learning environments. In fact, some research indicates that it might be very important to effectively engage large classes because, according to the University of Queensland's Teaching Large Classes guide, "Students will be more motivated if the environment is inclusive and respectful of their background knowledge, needs, interests and aspirations."[10]

Perhaps the most difficult aspect of teaching large lecture classes is creating ways for students to actively connect with the course material. This is especially difficult because, as studies have shown, the longer a lecture is the less material a student will

[7]University of Queensland, Australian Universities Teaching Committee Teaching Large Classes Project. 2001 "Planning and Conducting Assessment." http://www.tedi.uq.edu.au/largeclasses/
[8] University of Maryland, "Large Classes: A Teaching Guide." Op. cit.
[9]George Washington University, Center for Innovative Teaching and Learning. "Teaching Large Undergraduate Classes: A Guide for Faculty and Teaching Assistants." http://citl.gwu.edu/pdf/LargeClasses.pdf
[10] University of Queensland, Australian Universities Teaching Committee Teaching Large Classes Project. 2001. "Planning and Teaching." http://www.tedi.uq.edu.au/largeclasses/

retain.[11] Some professors combat this problem by interspersing short periods of lecturing with other activities, such as group discussions, solving problems, or interpreting a graph or figure. This model has been designated as the "Interactive Lecture" by the Science Education Resource Center of Carleton College, and is designed to engage with the students and allow them to interact with the material. The ultimate goal is that students will be more likely to pay attention, will get the chance to practice more frequently, and will retain more information.[12] The Science Education Resource Center describes one model for a class:[13]

> The class starts with a 5-minute "think-pair-share" activity: "Summarize the main points of the reading assigned for this class." Every class, it's the same topic, so students know what's expected of them and are motivated not to let down their friends. The discussion will focus them on the material, a good thing to do *before* lecture starts. It may be helpful to have them turn in their summaries on index cards for a minor grade, to discourage tardiness (especially in students who are trying to avoid this activity).
>
> Lecture for about 10-12 minutes, then ask a "ConcepTest" question to determine if they understand the topic and can apply the ideas in it to simple problems. Evaluate the responses. If the class adequately mastered the concept, repeat the process with a new topic. If not, a new lecture on the old topic, a "Socratic" Question-and-Answer session or some other relevant activity is in order. Use the same or a related ConcepTest question to see if the class now understands the topic.
>
> For the last fifteen minutes of class, spend the first ten answering questions from students from last class. How to get those questions out of students? Well, the last three minutes are for a think-pair-share activity to be turned in on an index card: "What are two questions that you still have on today's topic?" The instructor will review the most representative of these in the last lecture segment of the next class.

This interactive lecture model depends heavily on teachers switching between lecturing and supervising activities in order to better engage the students in the material.

In addition to the specific interactive lecture model of breaking up a lecture class with activities, there are also a number of short, in-class, assessments that professors can both use to create active-learning environments and to give students the opportunity to have input on how the course progresses. These assessments include pop quizzes, focused listing, and class evaluations. Pop quizzes are a good way of quickly assessing students' progress. Similarly, focused listing, when students are asked to

[11] MacDonald, H. and Teed, R. 2010. "Interactive Lectures." The Science Education Resource Center at Carleton College. http://serc.carleton.edu/introgeo/interactive/why.html
[12] Ibid. http://serc.carleton.edu/introgeo/interactive/index.html
[13] Ibid. http://serc.carleton.edu/introgeo/interactive/structure.html

write down key topics they remember from previous lectures, helps professors determine how much information students typically retain from lectures. Finally, class evaluations give students the opportunity to express their own opinions about how the course is progressing, allowing the professor to adjust accordingly.[14] These assessments achieve the obvious goal of allowing the professor to assess the effectiveness of their own teaching methods. Additionally, they allow students to engage more directly with the structure of the course, furthering an active-learning environment.

One more strategy for making large classes more productive and effective is to create opportunities for students to meet in smaller groups outside of the lecture hall, preferably led by a professor or teaching assistant. Discussion sections and labs are well-established institutions of large lecture classes and, when they are possible, help complement the lectures. The University of Washington's Center for Instructional Development and Research provides some suggestions on how to best run sections and labs:[15]

> **Communicate to students how section or lab meetings relate to the course as a whole.**
> Since sections and lab meetings are usually attached to larger courses, students are better prepared to learn when the links between these parts of a course are clearly defined…
>
> **Communicate to students what they can expect in your specific section or lab meetings.**
> Sections and labs vary in purpose from one course to another, so it will help students to know what your intended purposes are. Otherwise they may base expectations for your course on experiences in other courses…
>
> **Help students develop strategies for successful learning in your discipline and in your courses.**
> In many courses, students are exposed not only to new information, but also to new ways of learning and thinking about that information…
>
> **Help students become monitors of their own learning.**
> In many courses, part of what students are learning is to assess their own level of understanding or the quality of their work.

[14] University of Maryland, "Large Classes: A Teaching Guide." Op. cit.
[15] University of Washington, Center for Instructional Development and Research. 2003. "Teaching and Learning in Sections and Labs." *CIDR Teaching & Learning Bulletin*, 7:1. http://depts.washington.edu/cidrweb/Bulletin/Sections.html

According to this outline, sections and labs are best run when instructors clearly communicate with students about the purpose of such meetings, both in terms of how they relate to the course as a whole and the expectations placed on the students. These meetings are also more effective when they are specifically designed to help students develop and engage with the learning methods that will help them succeed in the course, forcing them to become active learners.

In addition to traditional sections and labs, some institutions have recently adopted other means of creating a smaller environment within large classes. The Freshman Interest Group (FIG) is a program that has been adopted by a number of large U.S. universities including University of Washington, Florida State University, University of Oregon, University of Texas, University of Wisconsin, and Missouri University. Through an FIG program a group of around 25 students will take two to three large lecture classes together, usually connected through an FIG seminar taught by a professor or staff member.[16] Some universities also incorporate peer mentors[17] and living arrangements[18] into their FIG programs. According to the University of Oregon:[19]

> A Freshman Interest Group (FIG) is a group of twenty-five first-year students who take two general-education courses together in the fall term. These are regular university courses that satisfy graduation requirements and are also open to non-FIG participants at all class levels. The FIG group within these larger classes is linked together through College Connections, a 1-credit course typically taught by one of the faculty teaching the two larger classes. Assisting in the course are advanced undergraduates who have demonstrated success in the courses in the FIG. These student mentors serve as teaching assistants to the faculty and arrange out-of-class activities that help new students become better acquainted with each other, the faculty, and campus resources.

Although FIGs function largely to help freshman get acquainted with being at university, they could also be viewed as a means to help students deal with large class sizes. In the smaller sections, students have the opportunity to discuss material brought up in the large lecture classes.[20] The FIGs function similarly to sections and labs; however, they also go beyond the traditional model by striving to create smaller communities, both intellectual and social, in the midst of large lecture classes.

Large lecture classes provide a number of unique challenges to instructors. However, there are a number of simple ways to teach these classes in such a way that they

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[16]University of Oregon. 2007. "Freshman Interest Groups." http://firstyear.uoregon.edu/FYP_Pages/FYP_FIGs.html
[17]The University of Texas at Austin. 2009. "First-year Interest Groups." http://www.utexas.edu/ugs/fig/
[18] Missouri University. 2010. "Freshman Interest Groups." http://reslife.missouri.edu/lc/
[19] University of Oregon. Op. cit.
[20] Florida State University. 2010. "About Freshman Interest Groups." http://undergrad.fsu.edu/FIG/about.html

remain learning environments that engage students and allow them to practice active learning. This goal can be achieved through good organizational practices, fostering student-faculty interactions, interactive lectures, in-class assessments, and creating smaller out-of-class groups.

Using Technology in Teaching Large Undergraduate Classes

A number of new technologies have recently been adopted to turn large lecture classes into effective learning environments. These technologies are mainly directed at improving lectures, creating out-of-class electronic forums, and developing in-class electronic tools. These functions are designed to promote active learning in high-enrollment classes.

Electronic Presentation Aids

Professors can use various types of technology to help them more effectively give traditional lectures to large classes. In a large class setting, students often have trouble learning all the material covered. Indeed, one study found that students may record "as little as 52 percent of the 'units of sense'" covered in a lecture.[21] This is due to the fact that students are liable to experience "attention breaks" in the course of a lecture.[22] Using technology to provide visual aids and make lectures more interesting is one way professors combat this phenomenon.

PowerPoint presentations are one of the most well-established ways that professors use technology to make lectures more interesting. With PowerPoint, professors can complement their lectures with images and the text of key concepts that students should record. In a 1996/7 study conducted at the University of Plymouth, students who attended a class that incorporated PowerPoint appeared to perform better on an examination than those who did not.[23] This being said, these days PowerPoint has become so widely used that students are less likely to view it as a new and interesting technology that can hold their interest. According to some sources, PowerPoint does not transform a passive lecture into an active learning experience. Indeed, at least one institution, Southern Methodist University in Dallas, Texas, is removing computers from classrooms because of the belief that PowerPoint presentations tend to stifle class discussion.[24]

Professors can avoid the danger of relying too heavily on PowerPoint presentation to give a lecture by making sure to incorporate a variety of different visual tools. If used intermittently, videos, overheads, and computer images can all help to break up a monotonous lecture and keep students' attention.[25]

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[21] Lowry, R. 1991. "Electronic Presentation of Lecture – Effect upon Student Performance." University Chemistry Education, 3:1, 18. http://www.rsc.org/images/Vol_3_No1_tcm18-7036.pdf#page=20

[22] Ibid. 18.

[23] Ibid. 20.

[24] Young, Jeffrey R. "When Computers Leave Classrooms, So Does Boredom." *The Chronicle of Higher Education.* July 20, 2009. http://chronicle.com/article/Teach-Naked-Effort-Strips/47398/

[25] University of North Carolina, Charlotte, Center for Teaching & Learning. 2000. "A Survival Handbook for Teaching Large Classes." http://teaching.uncc.edu/resources/best-practice-articles/large-classes/handbook-large-classes

In-Class Audience Response Systems

As previously discussed, one of the major challenges in teaching large undergraduate classes is engaging students and encouraging them to practice active learning. A number of new technologies have recently been developed to help facilitate this process.

The most common technology now used in large classes is an audience response system. Audience response systems include any number of hand-held devices that allow students to respond and interact with the professor.[26] One of the most common types of these devices is the "clicker," a small device that looks like a remote control manufactured by a number of companies, including eInstruction, iClicker, and Turning Technologies.[27] Turning Technologies expected to ship over one million clickers in 2010, with roughly half heading to around 2,500 university campuses.[28] Clickers generally include a ten-digit numeric keypad and some additional keys (e.g. "yes" and "no" buttons), allowing students to enter in a variety of simple responses to questions. Clickers have been used in a wide variety of subjects ranging from mathematic and biology to philosophy and psychology.[29] Though creative professors can incorporate clickers in to their classrooms in any number of ways, the Ohio State University's Learning Technology site suggests some common uses:[30]

> **Facilitate Class Discussion** - Facilitate discussion by polling students' opinions and discussing the reasons for their opinions.
> **Guide Lectures** - Collect immediate feedback about students' understanding of lecture topics so confusion can be addressed quickly.
> **Encourage Peer Instruction** - Allow students to share, discuss, and change their opinions before answering a question.
> **Collect Data and Perform Formative Assessment** - Collect data on course topics or learning preferences throughout the cycle of a course.
> **Offer Quizzes and Exams** - Decrease grading time by using clickers to collect student answers to quizzes and exams.
> **Take Attendance** - Record attendance in large lecture courses.

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[26]Caldwell, J. 2007. "Clickers in the Large Classroom: Current Research and Best-Practice Tips." *CBE Life Sciences Education,* 6:1, 9-20. http://www.lifescied.org/cgi/content/full/6/1/9
[27] The Science Education Resource Center at Carleton College. 2010. "Classroom Response Systems: Major Manufacturers." http://serc.carleton.edu/econ/classresponse/manufacturers.html
[28]Steinberg, J. "More Professors Give Out Hand-Held Devices to Monitor Students and Engage Them." *The New York Times,* November 15, 2010. http://www.nytimes.com/2010/11/16/education/16clickers.html?_r=3&scp=1&sq=more%20professors%20give%20out%20hand-held%20&st=cse
[29] Caldwell. Op. cit.
[30]The Ohio State University, Learning Technology. "Clickers." http://lt.osu.edu/resources-clickers/

Essentially, clickers allow professors to collect a variety of different types of feedback from students in large-class settings that normally are not conducive to student-faculty interaction.

In general, clickers have received positive feedback from both professors and students as a way of stimulating a more interactive learning environment. When used effectively, clickers can help students practice active learning in large class environments, often to better effect than traditional active-learning methods like class discussion. According to Margie Martyn, writing in the EDUCAUSE Quarterly:[31]

> In a normal class discussion situation, only one or two students have the opportunity to answer a question... A student who is unsure of the correct answer may be unwilling to take the public risk of being incorrect. One of the best features of an SRS [student response system] is that it allows students to provide input without fear of public humiliation and without having to worry about more vocal students dominating the discussion.

In many situations, clickers allow students to contribute more freely than they could in a normal class discussion. This is especially true in large classes where, even if they are willing to, there simply is not enough time for all students to contribute.

The ability of clickers to allow students to contribute in class while remaining anonymous is one of their most widely reported benefits. In one specific case study, data was collected on how students felt about using clickers in a large sexual health class. In the class, students used clickers to answer what could be considered embarrassing questions about issues in sexual health. At the end of the class, "Two-thirds of the class (66.2%) strongly agreed and another 21.1% agreed with the statement 'In this class, the clickers helped to increase class participation.'"[32] Ultimately, clickers both encourage everybody in a large class to participate and allow students who might otherwise be nervous about participating to contribute in a completely anonymous way.

Clickers have also proven effective in providing professors with feedback on students' progression in a course, allowing them to better address students' needs and concerns. In one example, a biology instructor discovered from clicker responses that even though 90 percent of his students remembered a rule of genetics, only 48 percent could actually use it correctly.[33] In response to these results, the professor

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[31] Martyn, M. 2007. "Clickers in the Classroom: An Active Learning Approach." *EDUCAUSE Quarterly*, 30:2. http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/ClickersintheClassroomAnActive/157458

[32] Vail-Smith, K., Blumell, C.and Elmore. B. 2006. "Using a 'Classroom Response System' to improve Active Student Participation in a Large Sexual Health Class."*American Journal of Sexual Education*, 1:2, 3. http://www.kent.edu/fpdc/technology/clickers/upload/using-a-classroom-response-system-to-improve-active-student-participation-in-a-large-sexual-health-class.pdf

[33] Caldwell. Op. cit.

had the students discuss the topic with their neighbors until they reached a better understanding.[34] This example is instructive in showing how clicker responses can allow professors to modify class time to better serve the students.

Clickers can also play a role in creating a better classroom environment. Professors commonly make students clock in as "present" with their clickers at the beginning of class. Additionally, by asking questions periodically throughout a class period, professors help ensure that students are paying attention to the lecture.[35] According to Jacques Steinberg, writing in *The New York Times*, "But the greatest impact of such devices… may be cultural: they have altered, perhaps irrevocably, the nap schedules of anyone who might have hoped to catch a few winks in the back row."[36] Used in these ways, clickers become monitoring devices, allowing professors of large classes to better keep track of who is coming to class and participating. Some professors have even made clicker use count towards a student's final grade, a practice that some professors reported as significantly increasing attendance.[37]

A 2008 study of clicker use at the University of Toronto provides insight into how professors commonly implement and perceive the use of clickers in large classes. In this study, 32 faculty members were interviewed about how they used clickers and how this had affected their classes. Eighty-four percent of the instructors claimed they primarily used clickers to ask conceptual questions with a single correct answer, a practice that 69 percent of the instructors believed to increase student engagement by forcing students to think and make decisions in class. Instructors also reported that using clickers they receive feedback on student understanding, the students receive feedback on how they compare to the rest of the class, and all students are involved equally, even those who would generally not participate in a discussion.[38] This study demonstrates how, at least at one university, clickers have contributed to the teaching of large classes.

One innovative use of clickers is the "Think-Pair-Share" model. The Office of Instructional Development at the University of California, Santa Barbara, explains that in this model the professor asks a question and then polls the students using clickers. The students are then encouraged to think through the question in pairs before the professor re-polls the class with the clickers.[39] In this example, clickers both stimulate discussion of material, encourage students to work cooperatively to

[34] Ibid.
[35] Steinberg. Op. cit.
[36] Ibid.
[37] Caldwell. Op. cit.
[38] Harlow, J. et al. 2008. "What's all the clicking about? A study of Classroom Response System use at the University of Toronto." http://faraday.physics.utoronto.ca/PVB/Harrison/Clickers/Clickers_PVB.pdf
[39] University of California, Santa Barbara, Instructional Development. 2010. "10 Ways UCSB Professors are Using Clickers." http://oic.id.ucsb.edu/student-response-systems-srs/10-ways-ucsb-professors-are-using-clickers

understand course material, and give professors feedback on the students' level of understanding.

Though clickers are the most common technology used for audience response systems, some universities are beginning to use programs that provide similar functions and can be downloaded to students' mobile devices. Poll Everywhere is one program that students can download to their laptops or other mobile devices and respond immediately to questions asked by professors.[40] Downloading this program is significantly cheaper than buying clickers; however, it forces professors to type in questions in the middle of class and is not comprehensive at collecting data on individual students.

Audience response systems, including clickers and program students can download, create an environment where more students are able and willing to participate in class, in the process encouraging active learning. This technology can play additional roles in providing professors with feedback and encouraging class attendance.

Using Electronic Resources Out of Class

Large lecture classes often do not provide students with much time to discuss and engage with the material, either in or out of the class. In order to combat this problem, universities have begun to adopt a number of new technologies that allow students to engage with course material in electronic forums. These forums include both social-networking sites like Twitter, Facebook, and Wetpaint and sites that have been specifically designed for education, like Blackboard and Hotseat.

All of these sites share the same similar goal of creating a place where students and faculty can have discussions and share information outside of the lecture hall. The creators of Hotseat, one such electronic forum, divide a classroom into two channels: the official channel consisting of interactions between the professor and students during a lecture, and a "backchannel" that consists of side discussions that students have about the material. Hotseat was designed to, "Create a backchannel for the course and have the instructor check in with it or use it explicitly during class."[41] Hotseat is just one of the sites that instructors use to create an informal backchannel where students and professors can engage with course material.

Detailed below are some of the specific ways that Facebook, Twitter, Hotseat, Wetpaint, and Blackboard allow professors to create online forums for large classes:[42]

[40] Poll Everywhere. 2010. "What is Poll Everywhere." http://www.polleverywhere.com/faq#cost
[41] Aagard. et al. Op. cit.
[42] See: Brown, M. et al. "A Dialogue for Engagement." *EDUCAUSE Review. 45:5, 38-56.* http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume45/ADialogueforEngagement/213924

- *Facilitate student-faculty communication:* All of these sites allow students to communicate directly with faculty.
- *Facilitate classmate connections:* Students can get to know each other in an informal (albeit electronic) environment and discuss course material.
- *Facilitate online discussion:* These sites can all be used to have real-time online discussions on discussion board.
- *Share information:* Links to pertinent sites can be shared through these forums. Professors can also post class information such as due dates and test information. This is especially true of Blackboard, which allows students to take tests and quizzes online, and Wetpaint, which is wiki-based and allows students and faculty to freely post and edit information.

Electronic forums can be powerful tools for professors teaching large classes, allowing for more discussion and interaction in large classes than was previously possible. There are a number of techniques for incorporating these sites into large classes in an effective way. One case study of how to incorporate online forums into the classroom is provided by Bruce Hull, a professor of Social Ecology at Virginia Tech. In Hull's class, students are divided into debate teams in which they design and defend an argument on Wetpaint. The different debate teams review and critique each other's arguments, all via Wetpaint. The online debates are then carried over into the classroom, where Twitter is used to further facilitate discussion when either there is not enough time for everyone to participate or when students feel shy participating. After class, the Twitter feed is then posted onto a Wetpaint discussion board where students continue the debate.[43] Using these methods in his large class, Hull transforms what could be a passive learning experience into one where students are encouraged to practice active learning and engage with both the material and their classmates.

Online forums are easy-to-use methods for increasing the effectiveness of large undergraduate classes. There are also some models for using the Internet in different, less discussion-based ways to produce an active learning environment. Just-in-Time Teaching (JiTT) is one model for a more customized way of using the internet in large classes. According to guidelines supplied by Indiana University-Purdue University Indianapolis, JiTT "is a teaching and learning strategy based on the interaction between web-based study assignments and an active learner classroom."[44] In the JiTT model, students complete web-based assignments, and then the professor adjusts the lecture and class-time activities after an analysis of the results of these

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Online College.org. 2009. "100 Ways You Should Be Using Facebook in Your Classroom." http://www.onlinecollege.org/2009/10/20/100-ways-you-should-be-using-facebook-in-your-classroom/
Aagard. et al. Op. cit.
Cornell University, Cornell Information Technologies. 2008. "Blackboard: Features." http://atc.cit.cornell.edu/blackboard/features.cfm
[43]Brown, M. et al. Op. cit.
[44] Novak, G. "What is Just-in-Time Teaching?" http://jittdl.physics.iupui.edu/jitt/what.html

assignments.[45] JiTT, and the Internet resources it employs, allow professors to make sure that their classes address the needs and concerns of the students.

Managing and Sharing Information Online

Large lecture classes can be logistically confusing for both students and professors. As a result, being able to manage and access information such as lectures, homework, tests and quizzes online can help students better prepare for class, and can help professors better organize class materials and track student performance.

There are numerous ways to post information online, including many of the tools previously discussed. Blackboard, in addition to its function as an online discussion board, is one online resource that is specifically designed for the posting and management of classroom materials. Blackboard offers the following features in course information management:[46]

- Webspace for course materials: Blackboard allows professors to post documents and multimedia resources.
- Tests and Quizzes: Tests and Quizzes can be taken by students directly on Blackboard.
- Digital submissions: Students can submit assignments to Blackboard.
- Grade management: Professors can calculate and manage student grads through Blackboard.

In this way, Blackboard provides professors with a powerful tool for organizing all of the information necessary for a large class. Additionally, by allowing students to access course information, submit assignments online, and take tests and quizzes it helps students in a large class, where communication with the professor can be difficult, to better manage their workloads.

Beyond Blackboard, there are a variety of other ways for professors to share information with students through the Internet. Many professors are now posting entire lectures, either as videos or as podcasts, online.[47] Though this strategy could discourage students from attending class, some professors believe the benefits of having lectures always available to students outweigh the dangers. According to David Green, an Environmental Biology Instructor at Florida Gulf Coast University, "Instead of being able to listen to me only in the classroom once a week with their

[45] Ibid.
[46] See: Cornell University, Cornell Information Technologies. Op. cit.
Blackboard. 2010. " Blackboard Learn for Higher Ed: Course Delivery."
http://www.blackboard.com/Solutions-by-Market/Higher-Education/Blackboard-Learn-for-Higher-Ed/Capabilities/Course-Delivery.aspx
[47] Church, E. "The big issue: large undergraduate classes." *The Globe and Mail: globecampus,* October 24, 2010.
http://www.globecampus.ca/in-the-news/globecampusreport/the-big-issue-large-undergraduate-classes/

eyes closed as they nod off in sheer boredom, students now have access to my lectures outside of the classroom and can listen to my stimulating discussions about human impacts on the local environment anywhere they choose."[48] To Green, students will be more likely to actually absorb lectures if they are given the chance to approach them at their own pace, which the use of podcasts allow. Podcasts and posting videos of lectures online are easy ways for professors to give students constant access to course information. Indeed, podcasts have become so widespread that *The Chronicle of Higher Education* has written a series of articles detailing how exactly to create them.[49]

Some universities and professors have begun to go beyond just using electronic resources to complement their lectures and are now beginning to use them to fundamentally change how large classes are taught. At McMaster University in Hamilton, Ontario, psychology professor Joe Kim combines lectures posted to the Internet with a once-a-week live class. He uses the live class to go beyond material he covers in the web lectures.[50]

New York University (NYU) has tentative plans to take this hybrid online/live lecture model a step further with a proposal to entirely replace some of its courses with lectures posted on the Internet. In the NYU plan, lectures for large classes would be provided only on the internet and professors would act as "faculty curators," helping to guide the students by meeting with them either in person or online.[51] This is an extreme plan and is yet to be implemented anywhere, however, it does provide perspective on how quickly and to what extent universities in the United States and around the world are incorporating internet technology into the teaching of large lecture classes.

Conclusion

Teaching large classes can be a challenging task. However, by using a number of organizational and teaching strategies, instructors can ensure that they provide an effective and engaging learning environment to their students. A wide range of new technologies are further helping instructors to approach these classes in ways that make them far more than just monotonous lectures.

[48] Brown, M. et al. Op cit.
[49] Watrall, E. "Podcasting Your Lectures 101: Recording." *Chronicle of Higher Education,* September 24, 2009.
[50] Church. Op. cit.
[51] Parry, M. "Mass Video Courses May Free Up Professors for More Personalized Teaching." *The Chronicle of Higher Education,* August 8, 2010. http://wiredcampus.chronicle.com/article/Mass-Video-Courses-May-Free-Up/123781/

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