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THE END OF TEACHING? THE USE OF ACTIVE TECHNOLOGY IN THE LARGE INTRODUCTORY ECONOMICS CLASS.

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Abstract An approach to teaching large introductory undergraduate economics courses employing existing active technologies is discussed. Through the combined and reinforcing use of before-class, on-line graded homework, extensive student-student and student-faculty interaction through discussion boards, regular on-line quizzes based on homework, question centered, interactive classes facilitated by the use of clickers, and the use of 'peer-instructors', the passive lecture course is moved towards an active, humanized, just-in-time, Socratic, teaching by objective, responsive, interactive, involved, personal learning experience for many (but not all) students involved. In addition, increased portability, flexibility and cost-effectiveness result with a 24/7, inter-continental aspect.

Background

I discuss an approach employing existing active technologies to replace traditional approaches to teaching large (200-400 student, easily scaled up) introductory undergraduate economics courses. By active, I mean technologies that assist in requiring students to be actively involved and engaged in learning on their own and with each other, rather than passively being 'taught'. These technologies also make the instructor an active responder, and a very busy person. (Note that active learning often refers to experiential learning, which is only partly incorporated in this approach. See for example Salemi (2002)). A key aspect of these technologies is facilitating the ancient art of asking, and getting students to ask, questions.

Through the combined and reinforcing use of before-class, on-line graded homework, extensive student-student and student-faculty interaction through discussion boards, regular on-line quizzes based on homework (using Course Management Systems CMS), interaction in class through the use of clickers (Personal Response Systems), and the use of 'peer-instructors', the passive lecture course has moved towards an active, humanized, just-in-time, Socratic, teaching by objective, responsive, interactive, involved, personal learning experience for many (but not all) students involved. In addition, the approach results in increased portability, flexibility and cost-effectiveness with a 24/7, intercontinental teaching aspect (Goffe and Sosin (2005), Lohmann (2005)).

Student reactions have been largely positive, based on anonymous on-line surveys and other student feedback. Of course, there are many different learning styles, including the non-learning, no matter what approach.

Below I note some short-comings of the lecture approach in general and some of the additional difficulties faced in large lecture classes. I then outline the 'active' approach I've taken, and provide samples of the details and the outcomes, from the point of view of the students, teaching assistants, and instructor.

What's So Bad About the Traditional Large Lecture?

Not only are large lectures generally boring to both students (those who attend and manage to stay awake) and the instructor, but they are inflexible, tend to teach what students might already know, provide little meaningful feedback to either students or instructor, allow for virtually no interaction between students and instructor, and encourage students to be lazy and let the instructor do the work for them. The large lecture lacks humanizing elements and allows students anonymity, and evidence suggests that they are remarkable poor in terms of imparting knowledge and skills.

Why do we still lecture? For one, it's easy and satisfying. By "covering" a topic we control the discussion, and have the illusion that we have imparted the knowledge to students, generally brilliantly. Since the instructor is engaged, he/she is fascinated by the lecture and fascinating to his audiences. Yet the problem, as Henry Adams noted, is that we are often saying what students could read (better) in a book in a shorter time. And time is being spent both on what most students could easily learn on their own from a competent textbook, as well as those topics that they have trouble with. Generally, students don't discover whether they know the material or not until it is too late – on a midterm or worse, the final. Even for that minority of students that regularly attend lecture, there is little or no possibility of in-class interaction or even a desire for it in a class of several hundred strangers.

Other difficulties in the large lecture follow from sheer size multiplying administrative tasks and problems non-linearly. Students missing exams, homework, and/or class, due to illness, family problems, the need to spend several weeks abroad --- all compound course management difficulties. Harsh policies regarding no makeup work, ignore the modern realities of student life, torn between academic, work, and facebook demands. Office hours remain an odd anomaly from olden days when one's 20 students might each occasionally stop in to chat or go over some particularly interesting question from class. It is remarkably inefficient to spend such time on the few students who wander in wondering what was done last week while they were away. Recitations have not worked well in my environment either, as they have gradually increased in size from 10-20 students to 30-40 students in each and are increasingly taught by technically very competent graduate students, rather unfamiliar and uninterested in undergraduate level material. And the administrative/scheduling problems are substantial, slightly made easier by the fact that few students attend, and less find the recitations worth while.

How To Provide An Active Environment in the Large Lecture ?

In a word, ask, and require students to ask, and answer questions. The very act of requiring students to answer questions poses a challenge that produces engagement and interest for most, and leads, in a chain reaction, to students asking their own questions. It also allows the instructor to see and focus on those areas that they can help with.

Through the use of on-line, machine graded homework done before class, frequent on-line quizzes, discussion boards for student-student and student instructor interaction, 'lectures' which focus on dealing with homework questions that were revealed to be difficult, as well as current events and jokes, clickers in class for attendance, interaction and proof of life, additional online applications, and 'peer instructors', the large introductory lecture becomes something quite different.

In addition to increasing student engagement, this approach develops students' ability to learn on their own, makes more efficient and interesting use of instructors' and students' time, and adds flexibility for students and instructors. The impersonal, large lecture course is somewhat humanized and personalized. Students can do homework and quizzes anywhere, anytime and get graded results instantly. Students interact with each other and with the instructor on discussion boards, again anywhere, anytime, asynchronously (often 2 in the morning and sometimes from foreign lands). Instructors can give regular, graded assignments in even the largest classes, as well as online quizzes done wherever the student wants, or in a proctored testing center. Instructors can review students' performance and (almost) automatically notify those who missed work or are performing poorly In class, electronic 'clickers' allow instructors to tabulate, display, and record responses to questions about material just covered, or homework, or opinions. Clickers can also be used to monitor and ensure attendance, and verify life

Student satisfaction with this approach over the last two years seemed generally high, based on a required (5 points added to total) anonymous after-semester, online survey in my large Introduction to Macroeconomics and Money and Banking classes. (following results are from several surveys).

- More than 90% of the responding students (244 responded of approximately 325 students enrolled) indicated that the approach was useful in helping them learn macroeconomics 16% indicated extremely useful, 39% very useful, 41% somewhat useful - less than 8% indicated little or not at all useful)
- 54% indicated that they enjoyed the course more because of the approach (more than what is not clear).
- 98% found the on-line graded multiple-choice homework useful in learning the material
- 70% found the discussion boards useful in learning the material
- 68% felt that they had learned more in the course due to use of the CMS.
- 89% felt that the instructor was more involved and helpful than in a traditional course thanks to the use of the discussion boards (31% much more, 58% somewhat more)
- 95% indicated that they felt the instructor "cared more about students' learning than in a traditional course" (44% much more, 51% somewhat more)
- 70% interacted, worked with, and got help from other students more than in a traditional course (52% somewhat more, 19% much more)
- 51% agreed that the class seemed smaller with this approach
- 94% liked the flexibility of the course

On-Line, Graded Homework.

Prior to each class week, students read the assigned chapters in the text along with other web-based material and answer 50-70 on-line, graded multiple choice questions selected by the instructor before class. There is immediate feedback, and considerable interaction through the discussion boards (below).

The questions are **selected** from a publisher provided test bank and uploaded to a CMS (Blackboard for the last two years, perhaps Sakai in the future) into a pool, from which they are presented as an online quiz due before the first class of the next week. The question order is random. The instructor is forced to focus on exactly what material is important and to convey this to the students through his/her choice of questions. And, as Colander (2004) notes: "…often in those questions most of the issues I would have raised in my class come up. But the issues come up as a dialogue with students, not with me up there lecturing."

Students are thus compelled to read the book and additional readings and thus benefit from generally brilliant 'lectures' that can be read anywhere, anytime. The homework also can be done anywhere and anytime students have web access, and late assignments are easily accommodated as desired. Homework is open book and students collaborate via the discussion boards, below. As dumb as multiple choice questions and answers can appear, the questions themselves were quite serviceable. Thus, "Which of the following encourages economic growth?", without the answers, is not a bad discussion question. Questions involving simple graphical analysis worked fine in multiple choice form when they sketched the graphs and shifted the curves on paper (as compared to having the CMS do it for them). There was likely some cheating in the form of collaboration, but my impression, reinforced by anonymous surveys, is that most (70-85%) of students mostly tried the homework and read the book before class. The fact that students were told that they just had to average 75% correct on the homework to get full credit reduced cheating as well, as did the ability to scramble the order of the questions for each student. Allowing students to redo the homework up until the deadline seemed to benefit some.

Most importantly, the students are more engaged and interested, if only through the fear of losing points/grades. They are compelled to keep up (or drop out), and they and the instructor have a sense of what they do and don't know.). Note that 71% of students on the anonymous survey rated the required online homework as good – "forced me to keep up, learned a lot looking up answers" while 21% rated them as great – learned everything by reading book, trying questions, looking up when necessary."

Discussion Boards.

The boards are a key element in developing the interaction that was common in days of old when classes were small, time seemed less scarce, and schedules more easily coordinated. Students actively discuss homework (and other issues, see below) with each other and the instructor and peer instructors, using the required on line discussion boards**.** They had a strong incentive to do so to raise their homework grades, because they had become curious/engaged with the material and they are basically social animals. Also, there are points given (or taken away) for not posting an 'adequate' number of messages or replies. They are assisted by the instructor and by a number of "peer instructors" - former outstanding students who are hired to join in on the boards.

I created forums/boards for: HOW TO QUESTIONS ("when is hw 10 due", "what's on the quiz", "what day is it"), COURSE CONTENT QUESTIONS relating to homework, text, lecture, etc, INTRODUCE YOURSELF for students to put a word profile if desired, with interests, etc, ECONOMIC BUT NOT COURSE RELATED QUESTIONS – "what's the best way to buy foreign exchange for travel abroad", "is WalMart monopolizing retail", COURSE, CAREERS, AND THE MEANING OF LIFE, COURSE SUGGESTIONS, INVESTMENT GAME QUESTIONS, HOW TO GET RICH QUICK.

Last semester, in an introductory macroeconomics class of 180+ active students, there were more than 4,700 postings (messages and replies), more than two-thirds by students, one-third by the instructor, ta's and 'peer-instructors' (the instructor spent his office-hour equivalent time posting/replying to 675 messages). Each posting was read 5-200 times, for an enormous amount of interaction (more than 120,000 'clicks).

The questions that students would have emailed, would have come to office hours about, would never have asked or gotten answered, were posted, replied to, read. This is something that

does not happen in large classes, or a large University, much. All the questions they don't ask in recitations (which were not used in my course in any case) were asked, and answered on the boards. The discussion boards are asynchronous, meaning that questions can be asked or answered anytime, anyplace and read the same way. Students being nocturnal, much of the student activity was after 3am, while instructor involvement was delayed to daylight hours. There was a substantial amount of students assisting each other with the homework. They felt free to post dumb and not so dumb and often not so relevant, but interesting questions. They often felt that the instructor and TA's cared and were watching and involved. I often answered "right, or good, or thanks" to an appropriate student reply to another student's questions. They sometimes said that they can't figure it out, but Sheflin will answer. There is much more of a feeling of connection, between students and with the instructor. There is also great insight into what they are thinking, both about course material and other matters (it's often not pretty, but always interesting). All, in a time effective manner

Some examples, from memory, not verbatim, by category. Difficult to convey the interaction – often a student posting will have 3-8 replies, ranging from "me too", to "look at page 34, to detailed and often excellent explanations. And each question and response may be read dozens and even hundreds of times.

HOW, WHAT,WHEN questions: (660 postings – questions and replies)

POSTING "When is the quiz, homework due, final, what's on the quiz, what should I read?"

REPLY "Look at the syllabus", or "Sheflin said that in Class" or "Never Mind"

all answered previously in class and on the syllabus and announcements. All the questions that clog up email, phone, office hours and often don't get asked or answered. Best of all, about 70-80% are answered by other students. Sometimes they will pointedly say: Sheflin said that in class today, or paste in the relevant part of the syllabus.

COURSE CONTENT questions: (700 postings)

POSTING "I don't get the mpc"

REPLIES student 1: "look at page 45" student 2: "the definition is just the change in consumption resulting from a $1 change in income" student 3 "look, if you earn a buck more, you'll spend some, but not al of it"

POSTING "I can't do problem 5"

REPLIES student 1: "me neither" student 2: "I think there's a mistake in the question" student 3: "Sheflin will help" instructor: "It was sort of a trick question, you had to remember that the CPI uses base year quantities in each subsequent year …"

OTHER ECONOMICS QUESTIONS (126 postings)

COURSE, CAREERS AND THE MEANING OF LIFE (326 postings)

POSTINGS "I'm thinking of the business school, should I go?" and "i think the mean ing of life is to make lots of money", AND "How do I get into investment banking" or "design" or "advertising"

COURSE SUGGESTIONS (318 postings)

FINAL EXAM REVIEW QUESTIONS (480 postings)

HOW TO GET RICH QUICK (95 postings)

IN THE NEWS (247 postings)

STUDENT ORGANIZED REVIEW SESSIONS (125 postings)

-students posted times/places for self-organized final exam review sessions

Classes and Clickers.

With the need to read out loud to the students eliminated, classes are used to apply course material to current event, to go over additional assigned problems and applications, and, using "Just in time" techniques (see for example Simkins et. al. (2004)), to review those homework

questions that a substantial percentage got wrong (the CMS provides a distribution of answers for each question). There is no lecturing (or at least, very little).

The use of clickers (PRS devices), further engages students even in the very large lecture hall. Of course, with points gained for attendance, participation and correct answers, attendance is dramatically increased and students more involved and awake (mostly). The instructor gets immediate feedback on how well they are following concepts, or at least, if they are alive. Used also for questions on teaching approach – did this work for you? The role of participation in answering questions (even mentally) has been associated with learning (Guthrie and Carlin, 2004), and even in a crowd, students are learning vicariously to some degree (Caron and Gely, 2003). The first question I ever 'clicked' was "How many of you would never, ever ask a question in class, even, can I go to the bathroom?" 70+% clicked that they would not. Yet everyone happily answers/clicks many times each class (5-10 questions per class).

The prime objective of the class meeting then is motivation, interest, and responding to questions driven by the concepts/questions students demonstrated they had trouble with. I tend to use the clickers to respond to questions I generate 'on the fly' rather than in advance. That is, I might start the class by asking a current events question like: "Recent discussion regarding raising income tax rates. Do you a) favor or b) oppose raising personal income tax rates?" and use the displayed bar diagram of responses to start a discussion of the macroeconomic effects, and the normative issues. Or "Recent article indicates that the dollar is falling against the euro. What is the impact on the U.S. economy? a). strengthen demand b) weaken demand" and use this to review international material. I'll also click some of the homework questions that a substantial fraction of students got wrong and go into discussion of the issues from there. And sometimes, I'll click "Do you get it?" or Which approach worked best for you?"

Interestingly, regardless of the question or the number of times it was repeated, I found that there was an upper limit to the number of students who would get it correct. That is, regardless of repetition, 10-15% of the class would continue to click the incorrect answer. Thus, I asked students to recognize Malthus' law in three successive classes (after they had read about it and done at least one homework question). In the first attempt, 68% got it correct. A brief discussion followed. Later that class, 91% got it correct when it was re-clicked. The next class, the same question (but not necessarily all the same students) received 79% correct clicks while the following class got 80% correct. What about the final exam? Only 62% got essentially the same question correct, but this was likely distorted by a large number of 'phantom' students who appeared on the final but had not been actively attending.

Two other approaches to clicking I experimented with, with amusing results. In one case, after a question was clicked and the results displayed demonstrating a bi-modal response pattern, I told the students to try to convince their neighbor that their response was correct, while I left the room. Re-clicking resulted in even more students clicking the incorrect answer. Some have suggested that group projects of this sort are useful if class-time consuming. In the other, I displayed the bar chart showing results as students were clicking their answers. It was interesting and instructive to see answers change as students responded to the classmates responses.

Course Assesment. Every other week, online, graded quizzes are administered in a 24 hour window (students chose when to take it within the window). The quizzes are 'random-block' meaning each student gets a different set of questions drawn from the previous two-weeks homework pool. The midterm is drawn from the first half of the semester's homework. Both quizzes and midterm are timed with one-question at a time and no backtracking, to minimize

cheating. The intent is to reinforce and repeat material to enhance retention. The quizzes and midterm count for only 20% of the course, with the traditional in-class, scanned multiple choice final worth 80% of the course. This weighting is intended to lead to long-term retention and a focus on what students know at the end of the course. The final is drawn from homework/quiz questions with additional questions covering the same material but drawn from a list of long-answer 'essential questions' I distribute.

Web-based and other active applications assigned and reviewed, including:

- Economagic – for data retrieval, gaphing and regression (a consumption function estimation exercise assigned and reviewed in class).
- Investment Game – students compete for $20 first prize, $10 negative gain prize and learn basics of investments and impact on and by the macroeconomy. Marketwatch, Investopedia, and other online sources
- Presidential Macro Simulation – macro model policy game.
- Fair Model (some semesters).
- Advisement modules

Additional Issues, In outline

- More frequent, personalized feedback to students on progress, deficiencies, etc. -- Dear Johnnie/Jannie emails, perhaps, based on work to date including clicks, hw, quizzes.
- More analysis of click performance
- Evaluation of impact of required homework/discussion board use on performance (shut down both for one topic).
- Virtual group projects where subsets of students assigned to collaborate on a web hosted project
- Prizes for the highest 'click' score

Conclusions

Why the end of teaching? As Henry Adams observed of the German educational system in the 19th century, "… he found only the lecture system in its deadliest form as it flourished in the thirteenth century. The professor mumbled his comments; the students made, or seemed to make, notes; they could have learned from books or discussion in a day more than they could learn from him in a month, but they must pay his fees, follow his course, and be his scholars, if they wanted a degree". Hopefully, we are moving beyond this. Indeed, some have suggested the traditional classroom experience might be effectively and inefficiently replaced with on-line, distance learning courses supplemented by pod-casts, videos, etc. Certainly for some, mature independent learners these can be effective (as can reading a textbook). For my target audience of young and sometimes very young adults, the human element providing discipline, pacing, structure, motivation, and most of all, responsiveness will be essential for the foreseeable future. But with growing class size, productivity gains supported by technology will be required and is partially available already.

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