

# Reversing the Lecture/Homework Paradigm Using eTEACH<sup>®</sup> Web-based Streaming Video Software

Julie Foertsch, Gregory Moses, John Strikwerda, and Mike Litzkow  
University of Wisconsin-Madison, College of Engineering  
1500 Engineering Drive  
Madison, WI 53706  
moses@engr.wisc.edu  
(608) 265-6567 Fax: (608) 263-4499

## **Abstract**

A new online streaming video and multi-media application called eTEACH (<http://eTEACH.engr.wisc.edu>) was used to reform a large, lecture-based computer science course for engineering majors. In-class lectures were replaced with videotaped lectures and other materials that students viewed on the Internet on their own schedule, making it possible to use the live class periods for small, team problem-solving sessions facilitated by the professors and a teaching assistant. By using the eTEACH application to transform course lectures into “homework” and free up the face-to-face class time for working on problems that were similar to homework assignments, the professors effectively reversed the lecture and homework paradigm of a typical large lecture course. A thorough course evaluation over two semesters showed that students who took the online lecture version of the course gave significantly higher ratings to all aspects of the course, including lecture usefulness, professor responsiveness, the course overall, and the instructor. Although a few students missed the opportunity to ask questions during lectures, about two-thirds of the 531 students surveyed felt it was easier to take notes and understand the lectures presented via eTEACH than it would have been while attending the same lecture live, and 78% of students appreciated the ability to view and review course lectures on their own schedule.

## **I. Introduction**

Prompted by calls from the National Science Foundation<sup>1</sup> and others, many schools of engineering have embraced the maxim that students learn best by doing. Requests from industry and a changing pedagogical climate have encouraged numerous professors of engineering and other disciplines to revamp their courses in ways that put less emphasis on lectures and blackboard illustrations and more

emphasis on team projects and group problem-solving exercises<sup>2-5</sup>. The goal of these changes is to give students more hands-on experience with the types of problems and team-based approaches that they will encounter in their professional careers. Nevertheless, even in courses where students spend much of their time working in small teams at computers or workbenches to solve problems, lectures may still be necessary. Before students can be effective team members or problem-solvers, they need to have a basic understanding of the problem domain, some background knowledge about how problems can be solved, and instruction on how to use the tools at their disposal. Some of this knowledge can be gained through reading textbooks or other course materials, but the professor him/herself often best conveys the knowledge that is the most specific to the particular problems the class is studying. For this reason, even professors who are proponents of student-centered “active learning” often find themselves needing to give the occasional lecture before the group exercises can begin.

- **The real problem with lectures**

Although many instructors must depend on lectures to convey information to their students at least some of the time, lectures have long been portrayed in the educational literature as an ineffective way of teaching: a passive one-way flow of information from professor to student<sup>3,6,7</sup>. The same could be said of textbooks and other reading materials, yet most educational theorists do not suggest eliminating a course’s text and written reference materials. So why are lectures such a problem? We would argue that the “problem” with lectures has more to do with their *timing* than their content or the way that content is conveyed. Disciplinary knowledge that is transmitted to students through reading is not seen as pedagogically problematic because students are expected to read course texts on their own time outside of the classroom. Lectures, on the other hand, occur during scheduled class time and often take up most of the available time that students and professors have to interact. If students ask questions of the professor or engage in constructive discussion with the professor and other students during the lecture, the lecture becomes more interactive, and, therefore, more worth the time that everyone is spending together. But if students do not ask any questions, as is all too often the case during lectures in large courses, particularly in science and math-based disciplines, the face-to-face time is essentially wasted. Most students would

have done just as well to read the professor's lecture notes or view a videotape of the lecture on their own time.

The most important time for students and professors to spend together is when students have questions and the professors can act as a source of knowledge or guidance. So when do students have the most questions? Most instructors will tell you it is *not* when students are listening to a lecture, but when they are trying to apply the principles that the professor or the textbook has explained. It is only in doing homework problems, either for an assignment or in preparation for an exam, that most students are suddenly made aware of what they do and do not understand. Similarly, for many professors, it is only in watching a student attempt to apply or misapply the principles being taught that they can visually see whether the student truly understands. In short, professors and students would both be better served if their time together were spent on problem solving, not on lectures. How much more would students learn from their professors (and professors from their students) if the lectures that normally took up class time were watched at home and some of the assignments that we normally call "homework" were done in class?

This notion of reversing the homework/lecture paradigm so that students are viewing lectures outside class and working on problems in class was used to redesign a large lecture course for engineers at the University of Wisconsin-Madison. The course, Computer Sciences 310 or "Engineering Problem Solving Using Computers," was developed to teach computer software and problem-solving techniques that should be useful to engineering students in their subsequent courses and engineering practice. The enrollment is 250-300 students per semester, mostly sophomores and juniors.

We attempted this reform in Computer Sciences 310 because both the students and the faculty had expressed dissatisfaction with the course. Students felt there was little connection between the lectures, which focused on mathematical methods, and their individual computer labs and homework, which focused on using the computer applications to solve problems. Furthermore, many students felt they were not getting the support they needed for the most difficult part of the course, learning the most effective and efficient ways to apply the mathematical methods in solving real engineering problems. At

the same time, professors had little opportunity to view first-hand the learning practices of their students. In the past, the course was taught with each professor giving two lectures per week to a class of up to 150 students. Then, once per week, teaching assistants would conduct computer labs for smaller sections of 20 students each. Typically, two separate lecture sections and a dozen or more lab sections were needed to accommodate all the students enrolled. This course format of a large lecture taught by a professor twice per week and a small lab taught by a teaching assistant once per week is similar to that of many university courses. Unfortunately, for courses with large enrollments, this format greatly limits the amount of individual contact between professors and students. Most professors have no way of knowing whether their students are truly understanding something until they see the students' scores on homework and tests. Even then, professors can often only guess how and why students arrived at the answers they did. When CS 310 was taught in the traditional lecture format, professors had no opportunity to observe the learning of their students first-hand and to observe the difficulties students were encountering using the computer software or conceptualizing how to approach an engineering problem. As a result, students weren't learning the things they really needed to know from their professors, and the professors weren't learning anything about their students' way-of-thinking.

- **Using “distance technology” to *reduce* the distance between students and professors**

Ironically, in the same time period in which lectures and the passive delivery of information are coming to be viewed as pedagogically unsound, many universities are exploring how to deliver entire courses over the Internet. In the last several years, the Internet has increasingly been used by institutions of higher education to open up academic courses to students who are not on campus or who would prefer to take courses on their own schedule.<sup>8,9</sup> When all of a course's lectures, readings, and assignments are placed online, anyone with a computer and Internet access can participate in the course from any location, at any time of day or night. One institutional goal of this movement toward computer-aided distance education is to make higher education more economical in the long run through an “economy of scale.” If all of a professor's lectures, syllabi, and assignments are digitized and put online, professors could spend less of their time teaching a larger number of students, and fewer of those students would be on

campus using the university's resources.<sup>10</sup> However, in reality, many educational researchers and faculty members have found that delivering a quality course online often takes *more* of a professor's time than teaching a face-to-face course of similar quality, at least for the first few semesters.<sup>11</sup> Educational research has consistently supported the notion that the best online courses are those in which professors strive to maintain an interpersonal connection with their students, something which becomes increasingly difficult as the size of a class increases.<sup>11,12</sup>

The second institutional goal of computer-aided distance education is to make higher education "more accessible," and for students who would not be able to take courses unless they were offered online, accessibility has indeed increased. But for the bulk of full-time students, most of who live on or near campus and could attend classroom sessions, the movement towards online course delivery has been a mixed blessing. While some students may enjoy the freedom and flexibility of online courses, asynchronous virtual environments can make one's professors and fellow students seem *less* accessible, not more. When all face-to-face classroom interactions are replaced by videotaped lectures and asynchronous email communication, the immediacy and engagement of face-to-face discussion is lost and the opportunities to get just-in-time answers and assistance from one's instructor are reduced.<sup>13</sup> For this and other reasons, there is considerable debate over whether using technology such as course websites, streaming audio/video, and online collaborative software to deliver courses entirely online have been enhancing the value and accessibility of higher education or diluting it.

Something that gets overlooked in the debate over using online technologies for distance education is how the same Internet technologies can be used to *increase* the amount of face-to-face interaction between students and their instructors. Suppose that all of the students in a face-to-face course watched the course lectures outside class on their own time schedule. What could be done with the scheduled classroom time that was no longer being taken up by lecturing?

## **II. Restructured CS 310 course – Web Lectures and Team Labs**

The CS 310 course was conceived in 1994 to introduce engineering students to personal computer problem-solving productivity software such as Excel spreadsheets, Maple symbolic computation

software, Matlab numerical solution software and programming languages such as Fortran and C. The formal programming languages were dropped in 1999 because the course curriculum was too full. Excel was dropped in 2001 because it was too lightly covered and other available short courses adequately taught the principles of Excel.

Until Fall 2000, CS 310 students attended two large lectures per week and one teaching assistant (TA) supervised computer lab. There were two lecture sections of 125-150 students each and 12-15 lab sections of 20 students each. The lectures covered mathematical methods used to solve engineering problems in six areas: (1) roots of nonlinear algebraic equations, (2) numerical integration, (3) systems of linear equations, (4) data interpolation and approximation, (5) ordinary differential equations, and (6) Eigenvalue equations. Symbolic computation focused on differential and integral calculus, analytic solutions of linear systems and ordinary differential equations. The computer labs focused on skill building in the use of Excel, Maple and Matlab. Self-guided computer lab tutorials were assigned each week where TAs assisted and answered questions as needed.

Starting in Fall 2000, the two lectures per week were replaced with a streaming video presentation featuring the lecturer, coordinated with PowerPoint slides and enhanced with external web references. This eTEACH presentation includes a dynamic table of contents that allows the viewer to select any part of the presentation or return to previously viewed parts with the click of their computer mouse. The eTEACH presentation is viewed using the Internet Explorer web-browser (Figure 1). Students view the lecture at their own convenience in a computer lab or at their dorm room or apartment if they have the proper Internet connectivity (DSL or cable modem). There are weekly online quizzes to encourage students to watch the lectures and read the course notes. The once-weekly skill-building lab is now called the “individual lab,” and students continue to work on computer tutorials at their own pace under the supervision of a TA.

The key change to this course is that the lectures (now on the web) and the individual lab are now reinforced with a new weekly capstone “Team Lab” where students work in three-person teams on a

problem that is assigned for the lab. The professor and one teaching assistant supervise each Team Lab section. The lab's computer tables are ergonomically designed so each team can cluster around a single computer (Figure 2). There are 12 computer stations in the lab with a maximum capacity of 36 students. Team members work together on the problem, helping each other understand the concepts, in preparation for the upcoming homework assignment on that part of the course content.

The weekly student schedule is shown in Table 1. For 250 students, there are now 13 individual lab sections and seven Team Labs. Each week is treated as a “module” that is relatively self-contained. Students may view or review the online eTEACH lecture relevant to the lab sections on any weekday, but the most advantageous days for viewing the lectures are prior to the Team Lab, as shown in Table 1.

The faculty and TA contact hour workload has increased in this new format. Whereas the faculty taught two lectures per week in the old format, they now teach four Team Labs per week. In addition to their individual lab assignments, the TAs also assist in two Team Labs per week. Furthermore, the labs are more challenging (and fun) to teach because the material is not simply fed to students in a one-way monologue. Instead, the professor is able to observe and guide the students' learning patterns as they attempt to solve problems in the Team Lab. The professor must interact with each team in the context of their progress on the problem and the many solution pathways that they choose to take. The professors have divided the Team Lab sections between them so that they teach two labs in a row. Course management is accomplished with a sophisticated course web page that includes a database, online quizzes, online grade recovery, and access to all of the electronic lectures and materials involved in the course.

### **III. Evaluation**

- **Methodology of the course evaluation**

In order to determine the impact of the revisions made to the CS 310 course, which included not only the use of eTEACH to distribute lectures, but also the use of professor-supervised Team Labs to teach applied problem solving, the instructors hired an educational researcher from the UW-Madison's Learning through Evaluation Adaptation and Dissemination (LEAD) Center. In the weeks before the new

CS 310 course began, this researcher interviewed the professors and the 12 undergraduate workers who had helped to revamp the CS 310 course materials, videotape the lectures, and place all of the materials on the Internet. With an understanding of the course objectives, the eTEACH interface, and all of the changes that had been made to the course, the researcher then developed an 18-question, online, beginning-of-semester survey that collected background information on the students, their confidence levels in various academic areas, and their attitudes towards working in teams. All students taking the course in either the Fall or Spring semester were expected to fill out this survey as part of their first homework assignment. During the fifth week of classes, after students in the Team Labs had just switched to new three-person teams, students were given a six-question online survey to evaluate their experience with the team they just left. These team evaluations were to be completed every time the teams were reconfigured and were meant to give each student a chance to reflect about their team's performance and his or her contribution to it.

Several weeks before Fall's semester end, a sample of eight CS 310 students were interviewed about their experiences taking the course, using eTEACH, working in teams, and interacting with the professors and TAs. The results from these interviews were used to develop an 80-question, online, end-of-semester survey that asked students about every aspect of the course. These surveys were to be completed as the last homework assignment. The surveys were completed by 98.9% of the 262 students who completed the course in the Fall and 97.5% of the 277 students who completed the course in the Spring. Finally, at the completion of each semester, professors and teaching assistants were interviewed about their experiences teaching the course and their students' reactions to the materials.

- **Key findings from the course evaluation**

*Student demographics:* Seventy-nine percent of the students in CS 310 were male, 21% were female, and the vast majority (87%) were white. These demographics are similar to those for undergraduates in UW-Madison's College of Engineering as a whole. Although CS 310 is a sophomore-level course, only 37% of the students surveyed were sophomores, while 44% were juniors, 18% were seniors, and 3% were freshmen. However, the Spring semester had a much higher concentration of

sophomores (44%) than the Fall semester (28%). CS 310 included students from all eight engineering majors, with students majoring in Mechanical Engineering, Civil and Environmental Engineering, and Chemical Engineering making up the bulk of respondents. About 70% of students had taken at least one previous course that required significant computer use.

*The use of eTEACH to deliver course lectures:* Students were surveyed extensively about the online aspects of this course including the use of eTEACH to deliver all of the course lectures. According to the survey results, which corresponded with the course website's electronic records, 75% of students watched all or all but a few of the online lectures, and 86% of students generally watched lectures prior to the relevant Team Lab. Fifty-eight percent of students viewed eTEACH in the college's computer labs, while 37% watched the lectures at home or in their dorm. The vast majority of the students took advantage of the fact that lectures were online to view material in ways that are not possible with live lectures. Eighty-three percent would stop lectures to take notes or check other resources, 89% would go back over part of a lecture in the same sitting, and 67% would re-watch portions of old lectures as a way to review for exams. When asked if it was easier to take notes to understand the material when viewing lectures on eTEACH than it would have been attending the same lecture live, almost two-thirds (64%) of students agreed, either strongly (27%) or somewhat (37%). The benefits that students mentioned the most frequently regarding watching lectures via eTEACH were:

- The ability to learn from lectures at one's own pace: If students were having trouble understanding a concept, they could pause an eTEACH lecture to consult other resources or could go back over that section of the lecture again.
- The convenience of watching lectures on their own schedule: While not having a scheduled live lecture required more self-discipline on the students' part, many students said that having lectures online allowed them to fit this course into crowded or irregular schedules that would have made it difficult for them to regularly attend scheduled lectures. Overall, 78% of students said it was more convenient to watch lectures on eTEACH than to attend live lectures.

- Watching lectures at times that were the most conducive to learning: Students said that online lectures gave them the ability to learn difficult material at the time of day when they were the most attentive or focused, as opposed to whenever a lecture happened to be scheduled.

Alternatively, the 36% of students who thought it would have been easier to understand the material if it had been presented in a live lecture mentioned the following drawbacks to online lectures:

- A number of students missed the opportunity to ask questions in the middle of a lecture and said that getting instant clarifications or elaborations from the professor would have helped their understanding. They also felt that professors are better lecturers when they can “read” students’ faces and see when people are confused. The eTEACH lectures allow no such instant feedback.
- Having printed course notes and the ability to replay lectures discouraged some students from taking notes. Although not having to take notes seemed convenient at the time, some students later realized they didn’t learn concepts as well if they didn’t write things down themselves.
- Some students felt the “more formal” and “more focused” setting of a live lecture would have encouraged them to pay fuller attention to the lectures. These students found it was too easy to be distracted by friends or recreational diversions when they watched the lectures outside of a lecture hall and said they took the videotaped lectures less seriously.

With all of these factors taken into consideration, 59% of students felt that placing the lectures online through eTEACH had a positive effect on their learning (42% said “somewhat positive”; 17% “very positive”). Twenty-five percent felt it didn’t make a difference, and only 16% felt it had a negative effect (13% said “somewhat negative”; 3% “very negative”). When asked what they liked most about the course, almost half (49%) mentioned the convenience and flexibility afforded by the fact that all of the course’s lectures, notes, assignments, and tutorials were online.

*The use of Team Labs to teach problem solving:* Because a number of UW-Madison’s engineering courses emphasize team projects and collaborative learning, most students entering CS 310 were already familiar with the pros and cons of working in groups. Nevertheless, there were still some

changes in students' attitudes about teamwork over the course of the semester. When students were asked to discuss the effect the course had on their attitude towards working in groups, 51% gave a response that indicated a positive effect, with 26% of students mentioning (in a separate question) that the newly added Team Labs were one of the things they liked *most* about the course. Forty-four percent of respondents said the course did not change their overall attitude toward working in teams, while 5% said it had a negative impact. The students who had positive experiences in Team Labs expressed the benefits as: (1) having multiple people's perspectives on how to solve a problem, including teammates who had expertise in different areas; (2) being required to explain one's problem solving-strategies to teammates, which improves conceptual understanding for both the listener and the speaker; and (3) being able to get help from professors and teaching assistants at the time when students need it most – while they are working on problems. Sixty-two percent of students felt that they had more interaction with their classmates in the team-lab version of CS 310 than in the typical large lecture course. Forty-five percent thought the Team Labs allowed more interaction with the professor than live-lecture courses, while 24% thought it was about the same. It is interesting to note that 31% of students thought they had *less* interaction with the professor than they would have in a live-lecture course, primarily because the new format meant they saw the professor face-to-face only once per week in the Team Lab setting as opposed to the two or three times per week that is typical in a live-lecture course.

*Overall impressions of the course:* The vast majority of students thought that both the underlying problem-solving strategies (85%) and the computer applications (88%) that they learned how to use in CS 310 would be useful to them in the future. Over three-fourths of the students finished the course feeling confident in their problem-solving abilities using Maple, Matlab and Excel. Almost 60% of the students felt that, in comparison to other courses they had taken, the online version of CS 310 gave them more control over the pace and method by which they learned the material. But as a trade-off for this greater degree of control, 64% felt the course also required more self-discipline than most courses. The course did not, however, require more *time* than most courses for 76% of the students. Forty-seven percent

thought it required about the same amount of time, and 29% thought it required somewhat less or much less time.

In order to get a sense of how the online lecture/Team Lab version of CS 310 compared with the previous version, we obtained the department's post-course student evaluations for each of the lecture sections of CS 310 taught by the two professors involved in this study from Fall 1999 (when the emphasis of the course was first changed from programming to problem-solving) to Spring 2001. The *content* of the course had changed little in this time period, but the replacement of live lectures with online eTEACH lectures and Team Labs had begun in the Fall of 2000. This allowed a direct comparison in the student evaluations of the professors before the course revision (three lecture sections over two semesters taught by two professors, N = 234) and after the course revision (four sections over two semesters taught by the same two professors, N = 415).

In these standard course evaluations, students were asked to rate eight things about the course and their professor on a scale of 1-5, with 5 being the highest score. The ratings students gave to the professors and various aspects of the CS 310 course showed marked improvements after the introduction of online lectures and Team Labs. All eight questions showed increases in the average rating given for both professors, but the most relevant questions from the student evaluations regarding the changes made to the course were those that asked about: (1) the usefulness of the lectures; (2) the professor's responsiveness to students, (3) whether students would recommend the course to others, and (4) whether students would recommend the professor to others. Table 2 shows the average rating given (on a scale of 1-5) for each of these four questions before and after the switch to eTEACH lectures and Team Labs. Table 3 shows the percentage of students who gave a rating of 4 or 5 (the highest two ratings) for each of these four questions before and after the switch to eTEACH lectures and Team Labs. Two-tailed t-tests established all of these increases to be statistically significant at the 1% level.

*Student recommendations for improvement:* One important aspect of the evaluation was to obtain the students' feedback about the various aspects of the new CS 310 course so that improvements to the website, the eTEACH interface, the Team Labs, the videotaped lectures, and other course materials could

be made from semester to semester. The following student recommendations were used over the summer to revise eTEACH and the CS310 course in preparation for the 2001-02 school year:

- Revise the eTEACH interface by adding a rewind/fast-forward button or other ways to go back and forward within particular sections of a lecture.
- Indicate the total time that each section of an eTEACH lecture will take to view in its entirety.
- Adjust the size of the slides that accompany lectures so that they can be viewed on smaller computer monitors.
- Allow a way to review the slides without having to play the accompanying lecture.
- Reduce some of the background noise and distractions from the videotaped lectures (some of which were taped outside).

Put the eTEACH materials on a CD-ROM so that they can be accessed without a fast Internet connection.

#### **IV. Conclusions**

We used the newly developed eTEACH online computer application to reverse the homework/lecture paradigm of a large lecture course in computer science for engineers, requiring students to view the course lectures on their own time via the Internet and using the live class time for group problem-solving exercises similar to homework. As the results from a two-semester course evaluation illustrate, the replacement of live lectures with online lectures and Team Labs significantly enhanced the usefulness, convenience, and value of the course for the majority of students. About two thirds of the students thought that viewing lectures online at their own convenience enhanced their ability to understand and review lecture material, and as a result had a positive impact on their learning, while only 16% felt it had a negative effect. Comparisons of standard course evaluation ratings before and after the change to online lectures showed that students who took the online lecture version of the course gave statistically significant higher ratings to all aspects of the course, including lecture usefulness, professor responsiveness, the course overall, and the instructor.

The following are the main lessons learned from our experiences in teaching and evaluating the eTEACH lecture version of CS 310:

- Web-based streaming video lectures can successfully replace conventional large lecture sections, with a majority of students preferring the web-based lectures.
- Web-based streaming video lectures can successfully increase the amount of in-class contact and interaction between students and professors in large lecture courses by allowing non-interactive lectures to be viewed outside class and using class time for small team problem-solving sessions facilitated by the professor.
- As has been found in numerous studies,<sup>14</sup> problem-based learning in student teams provides a richer learning experience for the vast majority of students, and for their professors, who are given the opportunity to see first hand how their students apply the knowledge they are gaining through the course.

On a larger scale, the results of this course reform and evaluation further suggest that, in spite of their poor pedagogical reputation, lectures can be an effective way of conveying course content if the lectures are used as just another “text” or source of information. To really function as a learning tool for the majority of students, lectures should always be supplemented with visual aids, additional references or texts, and ample opportunity for students to engage with their professors in applying the content of those lectures through problem solving, group discussions, or group projects. Online applications such as eTEACH provide this opportunity by treating the course lectures just like other course “texts”; as key references to be reviewed by students on their own time. Face-to-face class time may then be used for more pedagogically powerful interactive exercises in which the students attempt to apply their new knowledge under the watchful eye and helpful tutelage of their professor.

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Table 1: Weekly Schedule for CS 310 Students

Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
View eTEACH lecture Review for labs	View eTEACH lecture Review for labs	Individual lab sections View eTEACH lecture	Individual lab sections View eTEACH lecture	Online quiz due View eTEACH lecture	Team Lab sections	Team Lab sections

Table 2: Average student ratings given to course components for the two different versions of CS 310 (on a scale of 1-5, with 5 being the highest).

Version of course	lecture usefulness	professor responsiveness	recommend course	recommend instructor
Live lectures	2.95	3.66	2.42	3.34
eTEACH lectures/Team Labs	3.58	4.24	3.24	3.96

Table 3: Percentage of students who gave component ratings of 4 or 5 (the two highest ratings) for the two different versions of CS 310

Version of course	lecture usefulness	professor responsiveness	recommend course	recommend instructor
Live lectures	36%	60%	21%	50%
eTEACH lectures/Team Labs	57%	84%	44%	73%

http://eteach.engr.wisc.edu/330-2/Lectures/ODE2/top.html - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://eteach.engr.wisc.edu/330-2/Lectures/ODE2/top.html



00:00:00 [Mangroveville](#)

00:02:27 [What is an ODE?](#)

00:09:26 [Euler's Method](#)

00:12:28 [Example of Euler's Method](#)

00:16:19 [Matlab's ode45](#)

**00:23:35 [SIMPLE PENDULUM](#)**

00:32:25 [Predator-prey Model](#)

00:37:43 [Righthand Side of ODE](#)

## Non-linear pendulum Matlab script

```

clear;
tspan=[0,2*pi]; % set time interval
th_0=[pi/3,0]; % set initial conditions
% pend evaluates r.h.s. of the ode
[t,th]=ode45('pend',tspan,th_0);
plot(t,th(:,1))

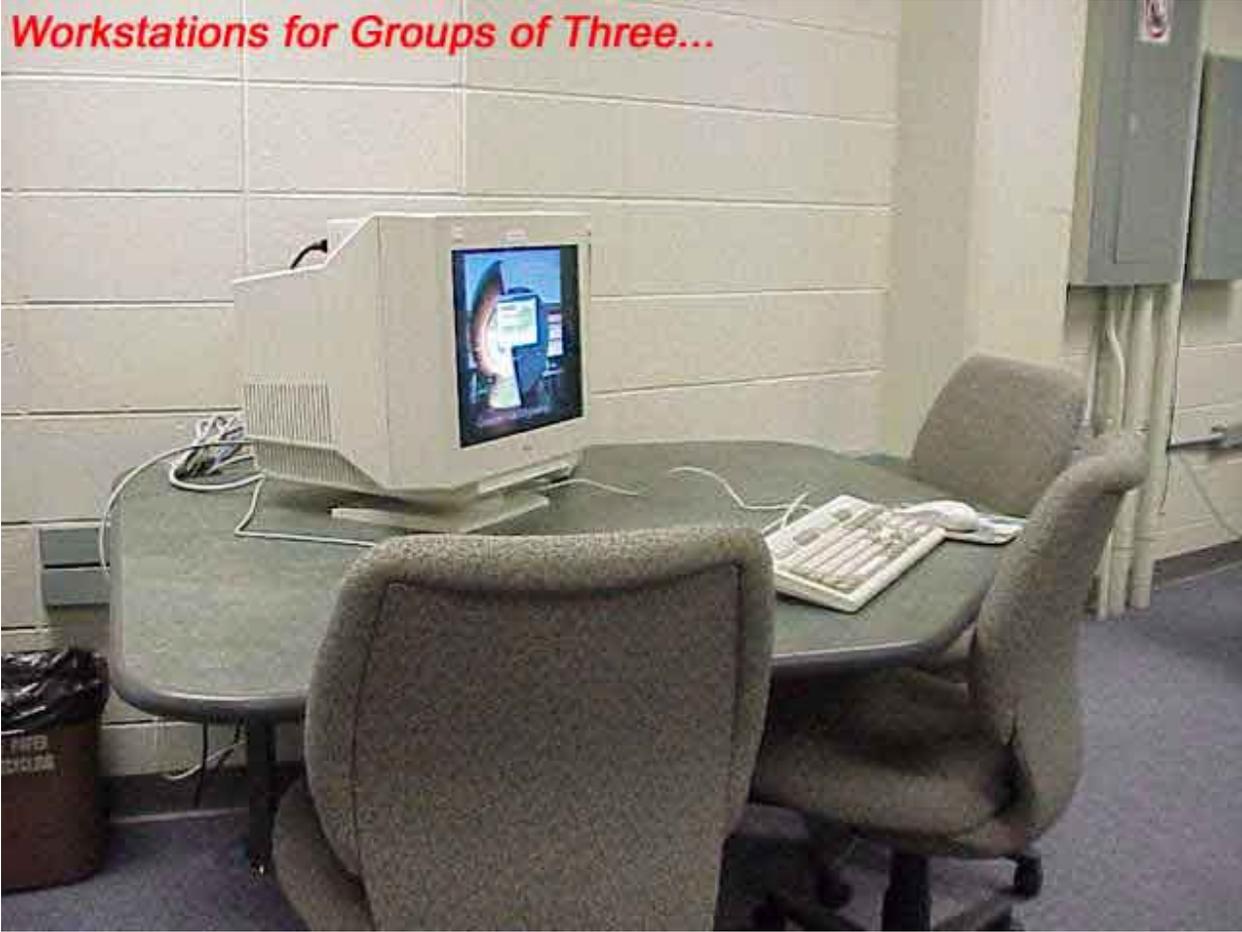
function th_prime = pend(t,th)
G=9.8; L=2; % set constants
z=th(1); % get theta
z1=th(2); % get thetal
zprime=z1; % compute theta'
z1prime=-G/L*sin(z) %compute thetal'
th_prime = [zprime ; z1prime];

```

Done Internet

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*Workstations for Groups of Three...*



List of Table Captions:

Table 1: Weekly Schedule for CS 310 Students

Table 2: Average student ratings given to course components for the two different versions of CS 310 (on a scale of 1-5, with 5 being the highest).

Table 3: Percentage of students who gave component ratings of 4 or 5 (the two highest ratings) for the two different versions of CS 310

List of Figure Captions:

Figure 1: Screen capture of eTEACH presentation.

Figure 2: CS 310 Team Lab 3-student workplace. (Courtesy of UW-Madison Computer Aided Engineering Center).