The Virtual Classroom: At the Cutting Edge of Higher Education

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September 28, 1995
Challenges to Learning

• Students in introductory courses need rapid feedback, while they are working on a particular subject.

• Students need to have access to TA’s and faculty when they are studying – not the next day.

• Faculty and TA office hours do not match student study hours.
Challenges to Learning

- We recognize the importance of active learning, but many students do not participate in a large lecture class.
- Teamwork is important, but it is difficult to get team members together outside of class.
- Students need sense of community.
Challenges to Educators

- We need to do more to engage all students in active learning.
- Retention in many courses is too low, and needs to be increased.
- What can we do to decrease costs and to increase faculty productivity?
How to Address these Challenges?

• We believe that networked computers and appropriate software can provide the answer to this question.

• Our original efforts began in January 1994 with funding from the Alfred P. Sloan Foundation - to restructure ECE 270 (Intro. to Circuit Analysis).
Background – ECE 270

• “Introduction to Circuit Analysis”

• ECE 270 is taken by ~400 students per semester.

• It is required in many engineering disciplines: aeronautical, biomedical, electrical, computer, mechanical, industrial, and applied mechanics.
What Students Learn

• Students (mostly sophomores) learn to apply fundamental laws to analyze electric circuits.

• They write equations based on fundamental laws, and solve for circuit variables (current, voltage, power). Problems have quantitative (numerical) answers.
Stand-alone tutorials provide rapid feedback and help at all hours.

Network-based homework & quizzes automate the process of collecting and grading students’ work.

Homework and quiz answers are submitted over the Internet via FTP to a UNIX server for instant grading.
This **CircuitTutor** module contains homework problems for a course in introductory circuit analysis, and these problems have been designed to be submitted over the Internet computer network for grading. In addition, this module can be used to obtain the results of each homework problem after it has been graded. The format of these problems is identical to that of problems found in the corresponding **CircuitTutor** modules, and you should make sure that you understand all of the problems in the appropriate **CircuitTutor** module before working the homework problems. Click on the right-facing arrow to continue.
Problem 3.5: Use the node voltage method to calculate the three node voltages, $V_1$, $V_2$, and $V_3$, in the circuit shown below. Enter your answers on the appropriate lines and then click on the "Done" button to submit your work for grading.

\[ V_1 = \ldots \text{ volts} \]
\[ V_2 = \ldots \text{ volts} \]
\[ V_3 = \ldots \text{ volts} \]
Filename: PR3PT5.RES

cstudent    ECE270A
HW Problem: PR3PT5
Time when graded: 6:52:27 AM, 4/19/95
Results of individual questions (1 = right; 0 = wrong):
1 1 1
3 out of 3 correct; 100 percent correct
Submitted on time; no late penalty.
Total score on this problem = 1.0
World-Wide Web

- Prof. R. Crang - Plant Biology 102

Quiz 2: The Role of Plants in Ecosystems

Network ID: c-studen  Password:  

1. Which is **not** true? Energy is stored as heat in plant bodies.

2. Ecosystems **have a continuous cycling of energy.**

3. Net primary productivity is the rate of energy storage less than

4. The building blocks of proteins are **amino acids.**

- simple sugars.
- nitrogenous bases.
- fatty acids.
- micronutrients.
World-Wide Web

- Prof. R. Crang - Plant Biology 102
World-Wide Web

- Prof. A. Hübler - CyberProf™

### Analyze the Launch

[review movie] [select image to see it full scale]

In which picture does the puck have the smallest velocity?

- Picture (a) ▼
- give a hint

checkanswer
World-Wide Web

- Prof. B. Whitmarsh - Chem 102b

Calculate $\Delta H$ (in kJ) for the synthesis of diborane from its elements

$$2\text{B}(s) + 3\text{H}_2(g) \rightarrow \text{B}_2\text{H}_6(g)$$

Using the following data:

- $2\text{B}(s) + 3\text{I}_2\text{O}_2(g) \rightarrow \text{B}_2\text{O}_3(s)$
  $\Delta H = -1273$ kJ
- $\text{B}_2\text{H}_6 + 3\text{O}_2(g) \rightarrow \text{B}_2\text{O}_3(s) + 3\text{H}_2\text{O}(g)$
  $\Delta H = -2035$ kJ
- $\text{H}_2(g) + \text{I}_2\text{O}_2(g) \rightarrow \text{H}_2\text{O}(l)$
  $\Delta H = -286$ kJ
- $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(g)$
  $\Delta H = 44.0$ kJ

$\Delta H = \boxed{36 \text{[kJ]}}$
Student Learning

• What happens when a student does NOT understand a certain topic?
• The student can discuss the problem
  • with a peer
  • with a teaching assistant (TA)
  • with a professor.
• There is a need for individualized attention – involving contact with other PEOPLE.
FirstClass Software

- Permits asynchronous conferencing using networked computers.
- Commercial product ($5 per user).
- Client-server architecture.
- Macintosh & Windows clients.
- Uses TCP/IP protocol.
- >3500 student users on UIUC campus.
FirstClass – Access

- The client software is installed on all CCSO and housing computers, and students can install the client software on their own computers.
FirstClass – Logging In

• Each student has a unique User ID - it is the same as the “Net ID” used with the on-line registration system.
FirstClass - Interface

- Has a graphical user interface – icons represent “conferences”.

![Desktop Interface Image](image-url)
FirstClass - Conferences

- Easy to organize on-line discussions.
Conferences can be “nested” to provide interaction on a very specific topic.
FirstClass – Threading

- Postings to a conference make up a "threaded" conversation.

<table>
<thead>
<tr>
<th>Conference</th>
<th>10 Files</th>
<th>0 Folders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pat T. Aaye</td>
<td>1K Re[3]: Help needed with Prob. 3.5</td>
<td>9/3/95 1:30 PM</td>
</tr>
<tr>
<td>Chris Student</td>
<td>44K Re[2]: Help needed with Prob. 3.5</td>
<td>9/3/95 1:29 PM</td>
</tr>
<tr>
<td>Pat T. Aaye</td>
<td>1K Re: Help needed with Prob. 3.5</td>
<td>9/3/95 1:27 PM</td>
</tr>
<tr>
<td>Chris Student</td>
<td>45K Help needed with Prob. 3.5</td>
<td>9/3/95 1:26 PM</td>
</tr>
<tr>
<td>Burks Oakley</td>
<td>16K Wilson’s question</td>
<td>9/3/95 4:34 AM</td>
</tr>
<tr>
<td>Kwong S. Lin</td>
<td>1K Re(3): How do I get started?</td>
<td>9/2/95 10:55 PM</td>
</tr>
<tr>
<td>Wilson Fung</td>
<td>1K Re(2): How do I get started?</td>
<td>9/2/95 10:51 PM</td>
</tr>
<tr>
<td>Kwong S. Lin</td>
<td>1K Re: How do I get started?</td>
<td>9/2/95 10:43 PM</td>
</tr>
<tr>
<td>Wilson Fung</td>
<td>24K How do I get started?</td>
<td>9/2/95 10:40 PM</td>
</tr>
</tbody>
</table>
Hi everybody! I am trying to solve problem 3.5 - the computer grader says two of my answers are wrong. :-( The attached picture shows my circuit and the three equations I wrote. Can anybody tell me what I am doing wrong? Thanks!
A student posts a question.

The attached picture shows my circuit and the three equations I wrote. Can anybody tell me what I am doing wrong? Thanks!
Virtual Assistance

• An on-line TA posts a response moments later.

Chris - Check your second equation. You wrote: $V_2 - 30 = V_3$. This is WRONG (your equation has a minus sign error). I think you need to review KVL. Let me know if you need more help with this problem. Good luck!
Thanks Pat! The correct equation was: $V2 + 30 = V3$. The computer grader says that my new answers are correct! Thanks for your help!!! :-))
Virtual Assistance

Virtual Assistance

Equation 1: \( V_1 = 40 \)
Equation 2: \( V_2 + 30 = V_3 \)
Equation 3: \( \frac{(V_1-V_2)}{80} + \frac{(V_1-V_3)}{20} = \frac{V_2}{80} + \frac{V_3}{20} \)

\( V_1 = 40 \) \( V_2 = -4 \) \( V_3 = 26 \)

\( V_1 = \) 40 volts \( V_2 = \) -4 volts \( V_3 = \) 26 volts

Your solution is correct! Thanks for your help!!! :-))
Remember that the first exam in ECE 270 is scheduled for Sept. 18th, from 7:00 pm until 8:20 pm. This exam will cover the material in Chapters 1-5 in the CircuitTutor Homework.

You may bring one 8.5" x 11" sheet of notes (front and back) to the exam. You may use a calculator on the exam.
Virtual Documents

- Can be read cross-platform (on both Macintosh and Windows computers).

Here are copies of Exam #1 from the Spring 1995 and Fall 1994 semesters. These files are "virtual documents" - in Adobe Acrobat format (*.pdf format). You can download these files to a Mac or Windows PC and open them with the Adobe Acrobat Reader - you also can print them out using this "reader". It is a good idea to work through old exams for practice before you have to take the actual exam.
Virtual Documents

- Macintosh to Windows, & vice versa.
Asynchronous Conferencing at UIUC

- Other UIUC faculty have started using FirstClass (or PacerForum) as a regular part of their classes.
- During the Fall 1995 semester, over 40 classes in 7 different colleges are using asynchronous conferencing.
Courses using FirstClass

- The “Classes” folder from “Instruct”.

- Image of a computer folder named “Classes” with various course folders.
  - ECE 271 Fa95
  - P1Bio 102 Fa95
  - Ag 100 Fa95
  - Econ 300 Fa95
  - ECE 270 Fa95
  - Writers’ Workshop
  - WS 332 Fa95
  - CLit 141 Fa95
  - Math 285 Fa95
  - Soc 222 Fa95
  - Ag Econ 339 Fa95
  - M&IE 393 Fa95
  - FN 240 Fa95
  - Chem 102B Fa95
  - UP 212 Fa95
  - Kines 300 Fa95
  - Biol 350 Fa95
  - Ag Econ 100 Fa95
  - FS 199 Fa95
  - Bioengineering 199
  - Bioen Fa95
  - ECE 375
  - Bioen 375 Fa95
  - Math 120 Fa95
Courses using FirstClass

- The “Classes” folder from “Collaborate”.

![Classes folder](image)
PacerForum

• Rhetoric 103 - Sibylle Gruber.
• Short essays - building community.
Legalizing marijuana has been a hot debate for a while now. I truly believe that if cigarettes and alcohol have the standards to be legalized, then so does marijuana. Don't get me wrong now I am in no way promoting this cannabis, but I feel that legalizing marijuana could open up a large, profitable industry which inevitably will open up more job opportunities. I also strongly believe that if this cannabis was legalized then a number of people who smoke it will decrease their habits because of the lack of the thrill they would receive. By thrill I mean that when people do things that are illegal and get away with it they get some sort of thrill that promotes them to do it over and over again. One reason why I think marijuana has not been legalized yet is because of the negatives that will be instilled upon those who promote the legalization of such a product. Politicians these days fear what would happen to their image if they promote such a substance.
Virtual Discussions

- English 493 - Prof. Gail Hawisher
Here's some further comments re: the ongoing crit. ped. exercise Stacy and I are conducting. I'm concerned about my students' current understanding of "rights" and whether a short term exercise regarding rights violations is fighting a losing battle due to their misunderstandings. To clarify, one of the readings handed out specifically talked about the legal definition of 14th amendment non-discrimination requirements. We read this section out loud. Yet still I had a student (an Asian international student) describe his personal rights violation as being when a car parked in his parking space and he had to have it towed. Admittedly, John Locke would say your damn right it was a rights violation: Property is a right. However, my student framed the story in terms of discrimination. I wonder if this student's response is generalizable or if it was a particular response due to his background.

A second comment. I found that almost all of the students' responses focused on the same thing: mistreatment by the police/security guard. I wonder if this is due to similarity of experiences or because these were examples students gave in class and other students, due to their lack...
Simulations

- Veterinary Pathology - Dr. R.D. Smith.
- Each team simulated (in real-time) a disease outbreak lasting 3 days.
9. Fecal culture on ferret feces 
NORMAL COLIFORM BACTERIA ONLY 

What are the results on the fecal? 

Histopathology 
Microscopically lesions of the intestines 
hyperplasia. The brush borders of the ent 
halves of most villi in the middle and lower 
severely parasitized by small, round (2 t 

Histopathology: Denuded mucosal epithelium with organisms consistent with 
Cryptosporidium parvum were found (see picture).
Increased Student-Faculty Interactions

I just have a few quick questions on Aristotle's writing's even though we are just about finished talking about him. Who specifically was Aristotle writing for? Who had access to these texts and who benefitted from these texts?

I am just curious to see if these writings were intended for the elite of the Greek society.

$$
98. Bob Jones 2/2/95 7:00 PM

You can assume that these texts were written for the elite of Athenian society. Not for the rest...
Hi. I was reading through some papers and thought I'd respond to yours, I hope you mind. I agree with your comments and they helped add a new perspective on to how thinking about the heros. I have a few questions for you though. Yes, Hektor's motives displaying her breast symbolized his vulnerability as a human, but can it symbolize a difference in Hektor's family and Akhilleus? Even using Hektor's relationship with wife and child as a reflection of how he was raised, can you see a difference (or many) between Akhilleus and Hektor? Hektor was faithful, he viewed the war as his job and destiny, but not really as his life, he was calm, decisive (relatively), and strong. Akhilleus was brought up in a half-god, half-mortal situation. You never hear about his father apparently has a wife, but is after the conquest of Bresies, he is totally indecisive, he is a spoiled little brat. I view Hektor as the greater of two heros by my non-Mediterranean perspective, and view Akhilleus as someone who needs a good sla. Anyway, just a few thoughts. Thanks for giving me a new perspective to work with, forward to reading more of your papers. -Beth
Learning Opportunities for Students

• Students are applying technology in many diverse fields.

This computer stuff is great!

Wednesday, September 6, 1995 9:15:04 AM
CLit 141 Fa95 Item

From: Hernando Rodriguez
Subject: This computer stuff is great!
To: CLIT 141 FA95

Last night I was reading the Illiad at Grainger Library. Since we are using the campus network, I strolled over to a computer, wrote my response paper with my campus network computer account, was able to edit what I wrote, and could spell check what I wrote :-). Now this morning on FirstClass I’m taking what I wrote last night and reworking it after reading other responses from other students. I’m probably putting 10 times more thought and time into the response paper with FirstClass than otherwise. Matter of a fact, I’m skipping my Biology class right now because of FirstClass!
• Faculty can add or delete specific discussion areas as needed.

Empowers Faculty
Efficient Use of Time

• Faculty no longer need to have weekly meetings with their TA’s.
Efficient Use of Time

- Faculty can work from home at convenient hours.

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Ask Prof. Peck

72. Meghan Sullivan 2/12/95 1:32 AM

Professor Peck:

When you take a quiz several times, does your best score count or does your last try count?

73. Tim Peck 2/12/95 6:14 AM

Meghan - your best score always counts on the quizzes.
Computer Conferencing

- Provides “virtual office hours” - at the times when students work.
- Provides cost-effective TA support to large lecture courses.
- Promotes teamwork.
- Builds sense of community.
- Increases student access to faculty and TA’s outside of the classroom.
Preliminary Outcomes

• Increased retention - fewer drops.
• Improved test performance.
• Very positive student evaluations.
• Less faculty time spent in meetings.
• More efficient use of faculty time - increased “transaction density”.
• No increase in cost - through more efficient use of TA and faculty time.
Improved Retention

• Average of previous 7 semesters in ECE 270 – 12.8% drop rate (ranging from 9.4% to 19.0%).

• Spring 1995 semester – we observed a 6.6% drop rate.

• The networked homework and the on-line conferencing system combine to provide additional support to the “marginal” students.
Impact on Course Grades

- ECE 270 – Fall 1994 – 2
“traditional” sections, 3
“computer-based” sections:

<table>
<thead>
<tr>
<th>Course Grade</th>
<th>Traditional</th>
<th>Computer-Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>17.4%</td>
<td>38.1%</td>
</tr>
<tr>
<td>B</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>C</td>
<td>31.8%</td>
<td>26.0%</td>
</tr>
<tr>
<td>D</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>E</td>
<td>35.6%</td>
<td>21.5%</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>6.8%</td>
<td>6.6%</td>
</tr>
</tbody>
</table>
In the Spring 1995 semester, we increased the student/faculty ratio in ECE 270 by 50%.

We taught four sections, with a total of 420 students (vs. five sections, 350 students, in the Fall 1994 semester).

No loss in quality of learning (55% of all students scored $\geq 90\%$ on Exam #2).
We have received additional support from the Sloan Foundation and the UIUC provost to implement the Sloan Center for Asynchronous Learning Environments (SCALE).

We are integrating Asynchronous Learning Networks (ALN) into courses in many different curricula at UIUC.
Goals of SCALE

• Evaluate the impact of these new ALN courses on certain outcomes:
  • Retention, time-to-degree
  • Economic issues (e.g., faculty productivity)
  • Faculty “quality of life”
• Provide a test of the value of ALN courses ON a campus.
• Disseminate our approach to other universities (especially CIC schools).
SCALE - Revised Courses

SCALE - Revised Courses

- **First Year & Discovery Program**
  - ECE 110, BioEng 199, Ag 100, FS 199

- **General Education**
  - Soc 122, Econ 102, AgEcon 100, CLit 141

- **Early Work in Major**
  - Biol 104 & 122, Econ 300, Chem 102, UP 212, PlantBio 100 & 102

- **Capstone Courses in Major**
  - M&IE 393, ECE 375, Kines 300, AgEcon 339
SCALE - Other Projects

• **Writing Across the Curriculum**
  - On-Line Writers’ Workshop

• **Advising**
  - Advising WorkBench (AWB)

• **Pilot Projects - Development**
  - Calculus & Mathematica
  - Women’s Studies
  - Classics
  - Other courses will be added
We have a major effort targeted at training:

- faculty
- teaching assistants
- students

Central to this effort are workshops, seminars, and the creation of detailed tutorials that are available on the World-Wide Web.
We also have a major effort targeted at evaluation of SCALE courses.

The evaluation is being conducted by personnel from the UIUC Office of Instructional Resources.

They are using direct observation, surveys, interviews, and comparative data in the evaluation process.
Implications for the Future

• Students and faculty will need increased access to networked computers both on- and off-campus.

• Faculty will need incentives to adopt new educational technologies and to develop new networked courses.

• There will be an on-going need for quality training and support.
The Virtual Classroom

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