Conversations on Technology

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This conversation also is available from the Learning Through Technology web site,
http://www.wcer.wisc.edu/nise/ct1/lt/
Conversations on Technology:
Using technology - is it worth it?

Question #1:
"I know that incorporating technology has taken an investment of your time. Before I dive in, I need to know... do you think it has been worth it? Did you accomplish with your students what you wanted to accomplish? I don't mean to sound skeptical, but how do you know?"

Well, some of the "worth it" part is a practical consideration. Using technology as a way of communicating with my students has made information more accessible to students and communication easier. Let me give you some examples. If I am busy or hard to reach my students can surely communicate with me any day of the week via e-mail. Using a web page disseminating information in my classes has decreased the number of students who say they couldn't get information about assignments, expectations, deadlines, etc. Putting an outline of up-coming class discussions and notes on the course home page has facilitated discussions during class meetings. Rather than copying my overheads furiously, the students fill in the spaces and spend the rest of the time interacting and thinking. Posting something I call "Questions of the Day" on the web prior to class meetings has helped students prepare for class discussions. Does this make students learn more and better? I'm not sure... but I do know it makes taking my classes a more uniform experience for everyone and it frees up some of my time. My suspicion is that students note taking is probably much better.

It is worth it, and, in the long run, unavoidable. It helped accomplish my goals, which are very rarely fully realized. It freed me of time taken drawing what are often bad pictures or slowly writing theorems in poor hand writing. It also forced me to be better organized. It allowed for increased communications since students could submit questions at anytime and get answers when I was able to have time at a computer, even while traveling. How do I know it helped? My evidence is purely subjective based on many years experience in teaching the subjects.

Well, I'm a skeptic myself. Most technological interventions in the classroom seem worthless to me and I don't bother with them. Once in a while technology allows you to do something you couldn't otherwise do, such as deal with a
large data set or a complex modeling problem that must be handled numerically. This kind of exercise is very useful to the extent that it embeds the mathematical problem in a real world setting. I know it is useful because of interview data from the students themselves. I know the students understand the point of the computer assisted exercise because they are always asked to write extensively about it. Sometimes technology allows for experimentation or visualization that helps with the understanding of a phenomenon. I don't have data from these sorts of uses, so I can't swear it was better than some other alternative, except that I was unable to come up with an alternative.

**Yes, it has been well worth it.** I make substantial use of Excel® in one course and Maple® in another. In both cases, the students respond very favorably. The use of Excel® has been especially successful. Many students have told me they have used Excel® extensively after the course ended, including in the jobs they have obtained. I also know that they have a better understanding of how the mathematics taught in the course is actually used. I see them using the tools, in ways that are impossible without the technology.

**There is an initial investment of time that is offset later.** Once you have developed the materials and learn how to use them effectively it takes a lot less time. I know it works because students perform better in assessment of understanding.

**Wow, this is a hard question.** I think that every minute I invested to incorporate technology in my courses was worth it and I would do it again. However, one cannot know the amount of investment when one starts. It is huge and all consuming. It is like a love affair, a passion that you cannot turn away from once you seriously start.

**With regard to accomplishing things with students...hmmmm.** That is a mixed bag of observations. Students are so variable. However, I can offer some observations and these may help. The first computer I got for p-chem lab was so welcome that students stood in line to use that 286. I had to give permission for security to let them in the lab to do home work. They loved the multicolor graphs they could prepare with the plotter. Later I got a 386 and color printer. That was even better. However some students were afraid to use the computer. They were very unsure of their skills and needed a lot of help to get started. This goes back about 10 years and I still find students resist the machines because of their lack of experience. One of the problems is that they
see it as another task that adds to their burden of study rather than a tool to use to learn better.

Well how do I know what students are accomplishing? This is a moving target question. Once I get one problem solved the problem changes and new challenges appear. First was the spread sheet problem. Students learned this and then the software got more sophisticated and I had to change the method of instruction. The software moves and then I move and then the students move to learn. The important thing is to set reasonable goals and then match challenge with support. I spend a lot of time with the students helping them to master software so they can get on with the job of using it to learn chemistry. I am committed to this because they will need to constantly learn software throughout their careers. So perhaps we should teach them how to learn on their own and get out of their way so they can learn. It is important to match challenge with support. It is important to let them have time to grow. Most come to p-chem with poor computer skills. My students now are doing amazing things with symbolic mathematics software. I help a lot but they are starting to teach me things. That is how I know they are successful. I listen to the types of questions they are asking me. The questions get more sophisticated as the use the software in conjunction with studying chemistry. Software usage in context of the normal curriculum. It is just like learning to use a calculator. I also know because the students teach each other. I must sometimes step back and let them do this. I have seen real growth in the class this year. Growth from resisting my unorthodox methods of teaching to acceptance and now even looking at my demands as a challenge. But I match challenge with support and sometime need to give them a day in class to just unload all their software questions or work on homework in class.

My goal in using technology is two fold:
1. Spark student's interest.
2. Explain concepts better.

I'm not sure yet, we are just starting to implement the most aggressive approach to IT in the CS 310 class.
Yes it is worth it--I accomplished what I set out to do, and the results were verified by comparing the scores of the traditional approach to the class using technology.

**Overwhelmed by the technology?**

**Question #2:**
"I use computers every day for e-mail, word processing and spreadsheets, but I'm not a technology wizard. I'm really concerned that I'm going to be overwhelmed by the technical challenges of starting up, and even worse by maintenance once I have things up and running. Did you feel this way? How has it turned out for you?"

At first I felt that way too, but you don't have to be on the "cutting edge" of technology. Talk to your colleagues. Find out what kinds of technology work best for them in their field. Then invest yourself in the more "tried and true" types of technology. Also there is much help available in most academic organizations. Computer services and educational technology services has a myriad of service available to faculty that you can use to get started, improve your skills and maintain technology in which you invest. I personally am no computer geek, but I run a computer network that is interface with chemistry probes and tutorial software. With the help of some computer adept students, faculty and computer services it runs quite smoothly.

You are right, it's a pain. Stick to one kind of software that is well supported by your institution. Use and adjust, if necessary, modules and data sets that colleagues have developed and used on students already. Know what you want students to get out of the exercise and make sure they get it by demanding that they analyze and write about their results.

Yes and you need to take this into consideration. You need good and dependable technical assistance.

There is an interesting story here. I learned computing with a mainframe and punch cards and then moved to terminals and now to PC's. It was a challenge
every step of the way for me to master technology while teaching a full load of four courses. I started by using what I knew and moved it into the classes I taught as I learned it. Even my non-science class had to do a spreadsheet assignment after I learned to use spreadsheets. I told them to find a buddy to help them. That is what I did. I asked my husband lots of questions and applied spreadsheets to our mutual research project as soon as I could. We published a paper using the data analysis we did with that first spreadsheet, SuperCalc3. I pushed spreadsheets into the p-chem course as soon as I had moderate skill. Why not. It is like any other instrument you can't wait till it is perfected or your skill is perfected. It is experimentation to include it.

I took workshops and still go to them to get ideas from others more experienced than I and less experienced than I. I recently went to one here on campus and learned what the Education folks are asking their students to do. Very interesting. they conduct a whole class through a discussion board even if the students are in the computer lab at the same time. This gives them the means to archive all comments and reflect on them. Sometimes the best learning is through reflection. Such reflection is similar to you and I here discussing IT. You are forcing me to reflect and that is good.

Again how do I know, ...by observation of student behavior.

Do I still feel frustrated. Boy do I, especially when I have too little time and the html formatting is not doing what I expect it to do. I feel overwhelmed all the time. However, I am too busy to dwell on this. I just push and push to learn what I need to know to continue. I ask lots of questions and get help from the wonderful IT staff we have here on campus.

Observation helps to. Imitate excellence when you see it.

My experience has been very positive. It does take some time to get up to speed, but not a huge amount. Also, you can start slowly and add more each year. Most of the time is well spent, since you also become more familiar with the tools and you then can use them in new ways.

It is very challenging. I am preparing Powerpoint slides with lots of equations and technical terms on them. I had to purchase a supplemental equation editor to do this. It was quite intuitive to learn, but nevertheless it did require some time on my part to become proficient with it. I let a TA publish my material to the course web page, and do not do it myself.
Be sure that you have the full support of your college or university as you begin activities with the Internet. Many times your institution will not have a clue as to what the real maintenance needs of an on-line approach to a course really means. Initially, any change in what you do in a course is time-consuming.

You can start by using commercial materials and have a technician or a knowledgeable student help you using the technology. You will be surprised at how easy it really is. Depending on which of many possible models you follow for technology use, the issue of equipment failure is a serious one. You need to use equipment that is under the auspices of an organization with good maintenance facilities and personnel.

The technical challenges are minor. If you know how to insert a CD and click a few icons, you are in good shape. The main problem is selecting what is good and useful.

The learning curve may be steep with some options, e.g., lectures in Tool Book® or Powerpoint®, perhaps less in distance learning lectures and discussions, more-so in group web site activities.

What can I do that's simple?

Question #3:
"I'm not ready to take on a huge learning technology development project. Can you give me any hints to give me a jump start? Something straightforward that worked well for your students? Or do you know of any resources on the web that I can draw from?"

I guess my major advice is to start small and then build. Start with email with your students. Assign them essays to write or questions to answer that they can send you by email. You can give them dead lines and then collect all the messages in a folder and sit and grade all at once and send personal
messages back in a day or two. Students like this. If your class is too large do this by groups.

**Use** the spread sheet program you know and have students do a project with that. Then collect the diskettes and review them at your convenience. Be careful of viruses. Students can handle the spreadsheet projects well.

**Web** resources are so rich I would be hesitant to have you do this first. I guess I would need to know what course you are planning to use the web in. In the general science course hear on campus so-and-so is using the web to have students examine science claims that are not valid. Her students are doing well with this project. You know she is developing a laptop course where students will be using the computer, special simulations, and the web in class. That may be too advance for you to start with. How about using the CD that comes with your text for that course in Inorganic Chemistry you are teaching. Just start by using it in the classroom to back up your lectures. You may want to talk to our own Dr. A who is upgrading the entire general chemistry laboratory course with computerized data acquisition. There are so many ways to go. You can almost start anywhere depending on the course you choose to infuse technology into. The important thing is to do something. Every step we take to prepare out students for a technologically rich career is a step in a forward direction. They need to see us learning even though we are professors. They need to see that it is possible for them to do so and they can if we give them the chance to grow under our tutelage.

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**Do small things first.** If you teach some statistics in your courses learn how to use spreadsheets and how teach statistics using spreadsheets. Perhaps the biggest hurdle is getting started. The way I learned web page construction was to write a grant in which I said I would put together a web page for a particular project. Then I wrote in release time and money to take a class to learn how. Because I had to do it for the project, I did it. Sometimes we need to give ourselves some motivation. Once you get started it really isn't hard to add on little bits of information as you go. Web pages don't have to be fancy to be informative and helpful. In fact some of the most useful web pages I have found were rather plain.

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**I found the easiest method to get started was to begin experimenting** and then to find the local experts and get a quick lesson or two. There is no substitute for trying to do things and then asking for local help. Most schools will have people ready to help. If yours doesn't, look for workshops. They are often held at both
local national meetings. Some people learn well from online courses, others need someone close by. The key is to get started and then look for help.

As I said there are others developing materials and you only have to select the ones you like (maybe later you'll want to make your own) and there are sites where you can get materials and evaluations of materials like the Journal of Chemical Education.

The people who have studied this and who say that technology is not the solution until you have a very good idea of what pedagogical improvements are needed are correct. Just putting lecture notes on the web, or using Powerpoint slides projected from a computer rather than overheads or writing on the board are not improvements in themselves. Technology only can serve to enhance the learning and teaching goals and it does not replace them.

You may start with occasional lectures projected via computer. Email correspondence is almost no learning curve for most of us. Web site use may be simple for merely posting problems, but more complex for interactive procedures.

I don't know any way to do it but jump in and spend the time.

The TI-89 computer algebra system calculator works well for my students. It is easy to use and very powerful for the kinds of computations currently encountered in the first two years of college mathematics, engineering, and science. It will also give you (the instructor) a feel for the ways in which this technology might affect what you teach and how you teach it. I would suggest looking at Calculus: Mathematics and Modeling to see how this kind of technology can be used in courses in science and mathematics. Be aware that such powerful technology will change what should be emphasized and what should be de-emphasized in your courses. Keep an open mind as you look at these materials since they will present material in a manner that is probably unfamiliar to you.

Learning a new presentation style will be difficult. If you think that you cannot learn new ways of presenting material, then you should not embark on this kind of activity. As your colleagues begin to use these technologies to present
material in their classes, you will become the traditionalist in your department. Your enrollments will suffer, but this probably will not have any affect on you prospects for tenure since research is the key to advancement at our institution.

Go to a web site such as Hotbot and do a search for a specific topic such as the Heisenberg's Uncertainty Principles while choosing the video or Java options. You can then download the movies to your desktop.

The calculus part of Dartmouth's MATC project has Maple based modules that you can use for calculus. I like Bob Devaney's web site at B.U. for dynamical systems experiments. Most Java applets on the web are junk, but I like his. My best advice is to convince your department you need a special technology TA until you are really used to the system. You can't spend 10 office hours a week JUST on fixing the students' computer troubles.

What failures have you had?

Question#4: "Have you had any failures in using technology from which I could learn?"

Just a few hints: Ask for help if you need it. Don't try to do it overnight.

Yes. Practice always before you use something. Try only what is value added from using technology, that is, if a drawing, a transparency or a Textbook photo is better by all means use it instead.

Everyone has some disasters. Students tend to be tolerant. Always have a Backup plan if the technology fails. Always allow extra time, especially on Exams using technology.

No, I have not had failures, yet. Don't forget to keystroke your instructions before you give them to the students.
Oh yeah! Wolfram once turned off the key served Mathematica® right in the middle of the quarter when labs were due. We don't use Mathematica® anymore. Maple® doesn't like being key served to an Apple® based system and runs slowly and crashes all the time. If more than eight computers try to talk to the same web site (e.g., Devaney's above) simultaneously in a lab based situation, the whole thing slows to a crawl. Hardware breaks regularly, preferably when you are trying to do a demo in front of 150 students. Disaster awaits around every corner, with every update of software. ALWAYS have an alternative at hand in case the system goes down in the middle of class.

Get there early to make sure the equipment is functioning. Putting slide shows on the web may alter them, especially in special effects and sound.

Computers and video equipment often crash.

The biggest frustration I have is that students are slow to adapt to what I expect them to do with technology. It is a barrier to them not a stepping stone to better learning. They need to be constantly reminded of the need to use technology and be given ample examples and exercises to do so. I had one failure, students refused to do the work I assigned and they took the F for the assignment instead of doing it. I know this has happened at another campus. Students will be students and have free will. They must be allowed to fail. However, we must not let them control how we structure the curriculum. Students are more conservative than physical chemists with respect to what they expect to do in a course. I have been all to glad to give up viscosity measurements to replace it with a molecular modeling activity in the p-chem lab.

I also failed when choosing a computer to use in the lab. This was a while ago and I was much less experienced then. I failed in some of my software choices. This too was due to lack of experience. After all experiments fail. We examine why and then move on to the next experiment.

I guess one should not try to bite off more than one can chew. This for sure will lead to failure.
I don't think I have had any failures, but you do learn about what works and what doesn't related to the specifics of what you are trying to deliver.

What did your colleagues think?

Question #5:
"I'm the first one in my department to consider using learning technology. How are my colleagues going to view this?"

They will think you are nuts and they will watch to see how much of your time it takes.

If you do not have tenure, you need to talk to the senior faculty and find out how to spend your time. If you are in a "research only" department, you need to know that and act accordingly. Once the tenure decision is made, then most schools appreciate curriculum innovation. You need to know the local traditions.

Like in everything, pioneers have difficulty at the beginning with their peers. Yes you will have some resistance but technology is here to stay. They are going to stay behind. Bring respected speakers to your institution to talk about the subject and support your interest.

Hmmm...I was the first in my department too at my previous job. My colleagues were interested. I already had tenure so I had nothing to loose. Technology gave me the opportunity to do research with two students and present the results at ACS meetings. Here I was hired to infuse technology into the courses in this department. The administration is funding younger faculty to develop projects. You should apply for a mini-grant to develop one or two applications for your classes. We are lucky here. I will be happy to read your proposal for you and give you some hints. Get in touch with the IT director. He will give you the names of some successful project developers and you can ask them how they are doing and what they are doing.
Unfortunately on some other campuses there are faculty who resist technology and think negatively about faculty who do get involved. I don't think we have such a problem here on our campus. We are lucky. You will need to talk to the Chair of your department about tenure requirements vis-à-vis IT in the classroom. Some departments give education development scholarship credit for this type of work for promotion or tenure. But be sure your basic research projects don't get neglected.

Your colleagues won't care. My time invested in learning technology was motivated by a software development grant of significant size, so I am not a good example to use.

My guess is that the answer to this may vary with department and course being taught. Mostly your colleagues will be sympathetic, except for those terrified by novelty.

In my department nearly all the faculty use technology. If they do not they often miss many of the changes that are happening in education today.

What did your students think?

Question #6: "For that matter, how are my students going to view this? Have your student evaluations gone up or down?"

My student evaluations have gone up in my introductory courses. Students seem to appreciate the use of technology and they often expect it.

The students have to be trained themselves, in order to understand the value of what you are doing. So, there has to be added value, which students find in real world problems. If it looks like more busywork, they will not like it at all.
Well, in the case of calculus, science majors appreciated the real world applications that the computer allowed us to do but non-science majors just found it an added burden. Folks that really hated the computer signed up for a different offering of the course. I don't know what you mean by "evaluations" because we evaluate many different things. It's not just a single number.

If you match challenge with support your students will manage and will not complain too much. Evaluations may go down for one semester in the course because students have not heard about the new requirements you are imposing in the course. Once the word gets out then they just accept it as part of the program and evaluate on normal issues as one would expect. However, today's students are changing. They expect technology so it is entirely possible that you will get the same or higher scores on evaluations. Again it depends on how you match the challenge with the support that students need to succeed. It helps to praise them regularly. You can catch more flies with honey than vinegar, but then you know that.

My student evaluations took a hit when I became chair here last year. I had such a learning curve for this job and on a new campus to boot that I was always too tired to give students the attention they needed. I am doing better this year and I expect continued improvement after this year is over. My research took a hit too but the supportive group I am working with filled in as I got settled here.

The student evaluations are no different than they have been.

Using new methodologies that you are unfamiliar with will almost certainly drive down your evaluations with students. They know how to approach courses in the old, traditional ways. They will see you new methods as ineffective and time-consuming (at least in the beginning). Change is difficult. But if you do not at first succeed, try, try again.

Students uniformly comment about how much they love having their assignments and grades available to them on the web. They also like having note outlines. They say repeatedly that the convenience of accessing this information over the web and not having to write so much in class is worth every dime. In case you think my students are rich this is not the case. I teach
in a college that is 72% first generation college students. Most pay their own way through school. They are poor, but they recognize a learning aid then they see it. Yes, I believe it has helped my evaluations. I know it has not hurt them.

I started last September so I don't yet have student evaluations to analyze.

**Salary increases? Promotions?**

**Question #7:**
"Did putting your time into learning technology help you obtain promotions or salary increases?"

Of course not.

No promotions or salary increases, although I have been compensated for the extra time that I have put in to the development process.

I did not get any salary increases. I did get a nominal stipend for attending a workshop on campus.

I got this job as chair of this department because of my use of technology in the classroom and the leadership I could bring here. So I have been amply rewarded for my efforts. My work has also resulted in several good peer reviewed papers in the journal of chemical education. This helped me get this job and get full professor at my prior place of employment.

I also got two Major DUE NSF grants funded. It took time (years) to develop the expertise in both technology and education but it was well worth the effort.

This did not lead to promotion, I'm a full professor. I have not yet seen my salary increase owed to me starting last Sept.
Is technology fair to all students?

Question #8:  
"I'm afraid that using technology won't be fair to all of my students. Have all of your students been able to deal effectively with your use of learning technology?"

Any method of pedagogy favors some and works against others. Students are not identical. Technology will be in the classroom and elsewhere very soon. Fighting it is a failing rear-guard action, much as the battle by those who opposed using paper and pencil since it would result in atrophied memory. Even if you are correct, you can't win the battle. Witness those who fought calculators. You will be giving your students essential skills they will need.

Students do not have problems with LT. It is mostly the faculty who have problems.

Not all my students have been able to deal effectively with my use of technology, just as not all of my students have been able to deal effectively with my lectures over the years. Lectures are not fair to all my students and neither are group work assignments. Many students, however, benefit from the use of technology and they will have to learn to use the ideas and skills of our discipline in a technology-rich environment that they will live in throughout their lives.

Four years ago I asked my freshman students how many had used e-mail and accessed the web. About 40% had. Today nearly everyone has. In fact it is mostly the non-traditional (older) students who have not. Let's face it. The world is not going to quit using computers. If students have to learn to use technology in your class you may be doing them a big favor. Most of my technology phobic students have thanked me profusely for helping them overcome their fears and getting them started. However you have to do this correctly. Give students room numbers where they can get an e-mail address. Tell them where computer labs are and tell them that they are manned with
people to help them. For a couple students that were really scared I actually went to the lab with them the first time. If you have a real phobic group do a group trip to the computer lab. I have never had a complaint about my use of technology in any class that I have ever taught.

My students have access to all of my multimedia material on the server.

As with most learning, some students are faster than others at using technology. You have to be ready to give the slow learners extra help, but that is always true.

Nothing is completely fair. Even text books give some students an advantage over others. That is the nature of living in our academic world. It would be more unfair to the students to not prepare them for the future they will find when they leave campus. They will be expected to be technologically literate. That is why everyone here on campus must take IT 101 or IT 102. It levels the playing field and we level the field more by letting students know what they need to know in the courses we teach and then give the resources to learn and some of the class time as well if necessary. It is part of preparing independent learns that permits us to do this.

Depends on what you are doing. If you use it in class to show animations then there is no problem, if you are asking students to manage the computer, internet, e-mail, then you should consider taking some time to teach the proper use. Or get some student to do the training for you.

Students today are getting used to dealing with technology. Those who have not been familiar have been able to learn quickly.

Other words of wisdom...

Question #9:
"I know you have to go in a few minutes. Any last words of wisdom for me? - Thanks so much - this learning technology business is a big step for me!"

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Remember that technology is only a learning tool. Technology is to a teacher what a calculator is to a mathematician or a periodic chart is to a chemist. It is simply a tool, which if used appropriately, can enhance learning. Good luck.

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Get in and try it - you'll like it.

Start small. Get one really good turnkey application that can only be done using a computer and that is very appealing to students. Make it the high point of the course. Discuss it to death in class, use it as the basis for all kinds of mathematical development. When you are so comfortable with it that it gets boring, then it will be time to introduce a second one. Also, software manuals are all unreadable. Find someone who can hold your hand while you write that first Maple® worksheet.

"Thanks so much - this learning technology business is a big step for me!"

Hey, no problem.

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Nothing succeeds without substantial effort. There is no royal road to geometry or the use of technology.

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Start with what you know and progress systematically from there.

Talk to folks you respect who are doing things and then do experiments and try. Students I think will respect an honest effort. They will see through a phony baloney professor who is not helping them to meet the challenges of their future careers.

Constantly remind them in a gentle unassuming way that this is what is done on the job and what they will be expected to know when they graduate.

Don't make too many changes at one time. Add semester by semester as your skills and energy permit.
Lean on others then pass it on to the new professors as they come on board.

Students like computers and want to use them for meaningful projects. Go for it...

"Thanks so much - this learning technology business is a big step for me!"

No problem. We have an excellent IT staff on campus. They are here to help and they like to help.

See if your department chair can reduce your teaching or committee load while you learn the process.

Learning technology should be applied very thoughtfully. Otherwise a lot of time will be wasted doing things that have no positive effect.

So-and-so of the University of Arizona has said that you should obtain the full level of tenure and promotion that you intend to have in your life before you embark on curricular revision or reform. I think that in many four-year institutions he is correct. Be careful.

Try it, you'll like it! In Spanish we say "if don't taste it you'll never feel the good taste."

Other comments...

Ending Comments #10:
"We would also appreciate it if you could briefly describe how you use technology in your instruction, if its not obvious from your answers above. This will provide context for your answers."

I have mostly used email and machine produced lectures. I am planning distance learning experiments. I have investigated, but not yet used interactive
web site based teaching for graduate courses. I am in the process of producing CD-ROM based videos for student to watch at home for self-paced learning.

I am a technophobe myself. The calculus example above is taught by a colleague. I have used Devaney's web site and it is idiot proof. We need more of those. More advanced students sometimes do projects, but they choose which software they wish to use and figure it out for themselves. Slightly older students respond OK to the idea of a "learning community" in which the instructor is not omniscient. As long as I don't have to be omniscient I don't mind working with students who are using technology.

I and Professor A are teaching 310 (taken by all ME, ChE, and CEE students). We are eliminating the large passive lectures and replacing them with streaming video web-based lectures delivered with eTEACH®, a software product developed under NSF sponsorship. The lectures will be replaced with a skills lab session and a problem solving lab session where students work in teams. The College of Engineering is developing a computer equipped studio classroom for the problem solving lab. This will be taught for the first time in this format in Fall 2000.

I use demos in class (CD ROMs), graphing calculators with cbls experiments and analysis of experiments, e-mail communication and have students obtain information from internet.

I teach a course in Written Business Communication, entirely on the Web with e-mail interface.

Well I must admit my hands are tired of typing. I used technology in general chemistry to present PowerPoint® lectures. This took about 1/3 of each class time. I used CD animations from the JCE (Journal of Chemical Education) CD's I purchased. I used WebCT to post student grades for the entire semester for all sections of the course. Students did electronic homework with the ChemSkill Builder® software. That was very successful to promote learning and compliance with homework. The students used Excel® in lab and my
colleague wrote an Excel® work book that our students use. We use automated data acquisition in the general chemistry laboratory for 5 experiments out of 12 for each semester. Students have a CD with their textbook for study and review and simulations.

In physical chemistry the students use Mathcad® symbolic equation software to do homework and all lab reports. We do some work with Mathcad live in class. Students have access to the Mathcad® library of programs that I maintain as a service to the chemistry community. We use email and Discuss to involve students in collaborative projects with students on distant campuses. We use the automated data acquisition devices in p-chem lab too.

I use graphing calculators in all my classes. I am beginning to use PowerPoint® presentations in my statistics classes. I use Maple® and the TI-89 in my calculus classes. I am currently using the ALEKS tutorial software in my intermediate algebra course to fill in the gaps in my students understanding of fundamental ideas of algebra. I have co-authored a textbook that requires the TI-89 on essentially every page. I am a co-author of the ODE Architect, an award winning numerical ODE solver with multimedia tutorials and projects on modeling the real world.

Web pages, tutorial software, spreadsheet data analysis, professional presentations, data acquisitions in laboratory experiments, lab reports.