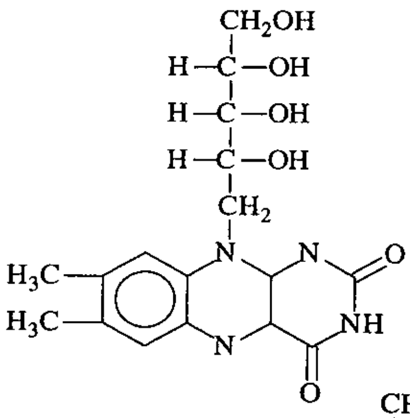
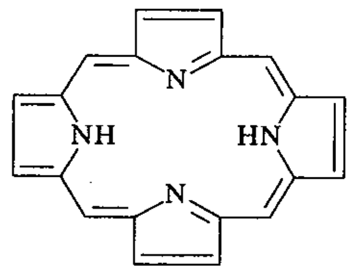
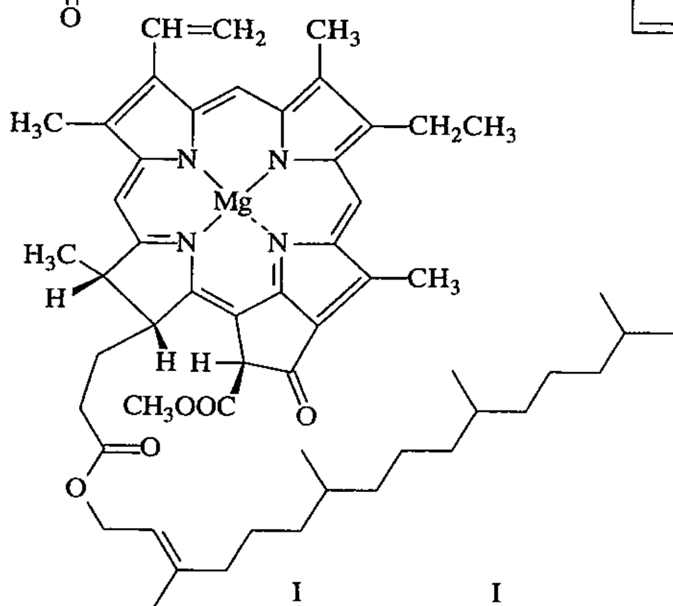
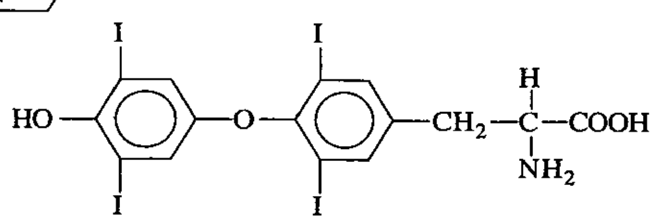
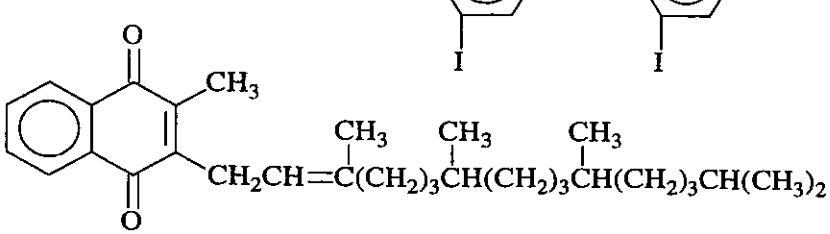
Computers in Chemical Education Newsletter
Fall 1998











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Editor Brian Pankuch, Department of Chemistry, Union County College, Cranford, NJ 07016 pankuch@eclipse.net, or pankuch@hawk.ucc.edu..

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Donald Rosenthal, CCE NEWSLETTER, Department of Chemistry, Clarkson University, Potsdam, NY 13699-5810.
ROSEN@CLVM.CLARKSON.EDU.

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Chairman's Comments

WHERE DO WE GO FROM HERE?

Harry E. Pence
SUNY-Oneonta
pencehe@oneonta.edu

In the previous issue of the Newsletter, my editorial focused on the achievements of the CCCE under the chairmanship of Don Rosenthal. This was appropriate, since these accomplishments have been significant. It would be a mistake, however, to think that the work of the Committee is largely completed. The changes in chemical education in the past few years are only a prelude to what lies ahead.

Let me give you an example of how far we have to go. Two years ago, during the ACS meeting in Orlando, I attended a symposium on the international chemical industry. My main motivation was curiosity; how have changes in communications affected the way that chemical companies do business? The answer surprised me.

One speaker discussed the development of a new product, which began with an initial discovery at a university in Massachusetts. Then the Massachusetts group worked with the main company laboratory in New Jersey to confirm their results. There was almost no face-to-face communication; the two groups exchanged information mainly by means of teleconferences and electronic mail. Next, a pilot plant in Holland was brought into the process, and now all three groups communicated by telecommunications. Finally, a production plant in the Carolinas produced the product, while all four groups now cooperated by means of electronic communications.

As I heard this description, I could not help but ask myself, "Are we preparing our students to work in this kind of workplace?" When I looked around the room, I was startled to realize that I was probably the only chemical educator present. The total audience was only a dozen people, and most of them were the speakers from the symposium. It left me with an uneasy feeling about how far we in higher education have to go in order to give our students a solid preparation for the world they will encounter after graduation.

This fall I attended the ACS meeting in Boston and came away with at least a partial answer to my concerns. During a symposium organized by Dr. George Long (Indiana University of Pennsylvania), a member of this Committee, I heard several papers that described how electronic collaborative methods were being used for teaching. In two cases, consortia of professors from several different campuses had created an opportunity for their students to work together in the physical chemistry course. Another paper reported on the latest On-Line Chemistry Course, in which students from several different campuses work cooperatively. I was delighted and gratified to note that many of the faculty who are involved in these projects are members of the CCCE, and, of course, the On-Line Chemistry Courses are sponsored by this committee.

Higher education will not adopt new technologies overnight, nor will there be an immediate consensus about how to use these technologies for teaching. The process of exploring and implementing new methods will require both time and dedication. One job of the CCCE is to test the most promising new technologies. There may still be a long way to go before I can be satisfied that we are preparing our students for the new world of telecommunications, but the members of the committee are working hard to learn how to do this. It is clear that the CCCE has a full agenda for some time to come.

Multimedia in Lecture
First Attempts

Brian Pankuch, Editor
Pankuch@eclipse.net

Lady luck came through for us at my college and we obtained some funding for updating computer equipment. I was able to purchase a Mac PowerBook 292 Mhz/9 G HD, and 160 M RAM. It's got a 14.1 inch active matrix screen and is probably the fastest laptop available at the moment.

I'm using it with an Epson 5000, 750 lumen projector. This is bright enough to work with lights on, though I tend to shut the lights at the front of the room off. I project the PowerPoint lectures on the sidewall, this leaves me with the freedom to use the front board, to answer student questions.

I queried a number of people about the methods they find most effective and I'm trying two with somewhat different emphasis. One is based on some of the ideas in 'Peer Instruction", by Eric Mazur Prentice Hall, 1997 ISBN 0-13-565441-6.

One class is getting more short questions projected, that they try to answer. This gives me some idea of how they are understanding the topics. The second is getting more special effects with short QuickTime movies. I can project movies full screen with sound with no problem with the PowerBook. I'm also using Director animations that I've made up.

A great help has been using computer programs to generate examples live in class. For instance I'm currently going over g->mol type problems. After going over the basic ideas and definitions I project a g->mol program. Then select a problem and show the students how to do the problem using the program. The program is set up so all interaction with the user is by choosing from 4 multiple guess answers, A), B), C), or D). It has a built in tutor to walk the user through setting up a problem map or unit path then filling in step by step, with student input, each 'conversion factor' that makes up the map.

If you have set this up in PowerPoint you realize it can be very time consuming to do. Not for me I just click on a button in my PowerPoint lecture and the link starts up the program. I can show a variety of problems (random number generators give a choice of a large number of potential problems) and have step by step interaction with the class in doing the problem. I can have students hold up cards containing A), B), C), or D) to indicate their choice at a each step of the solution. This gives me immediate feedback of how each student is following the solution. The students have already been in the Mac lab and know how to use the programs, so this reinforces using the programs.

I want to reinforce this since we have been using programs for over 5 years and students who use them for more than a few hours show 2-2.5 grades higher on tests than those who don't. My projector has a zoom lens and a custom zoom (software) feature that allows me to make the program window quite large. Some of the programs have simulations available that project quite well.

The problem of students taking down every word of notes vs. others who take briefer notes, is more obvious with PowerPoint than with a board. Using chalk you have several boards to keep material up for a longer time. With PowerPoint some are getting fidgety while others are still busy writing. If you've come up with a solution to this let me know.

Note taking is helped by using computer programs that the students have access to. The students can use the programs themselves and work through similar problems- with less need to take detailed notes.

Multimedia in Lectures and on The World Wide Web. Part 2

Brian Pankuch, Editor
Pankuch@eclipse.net

Abstract:
How effective and efficient is the use of multimedia for learning in lecture and on the Internet? Most results are anecdotal and show positive outcomes, with students being enthusiastic about new methods of learning. It appears that most of this effect can be ascribed to using multimedia methods students are not familiar with (Hawthorne effect). No proof was found that multimedia learning is more efficient, i.e., that more is learned during the same time spent studying. Students did spend more time with the multimedia, so they learn more due to the increased time spent not because multimedia is inherently more efficient. This does not make the additional learning less meaningful.

It does suggest that a model for developing and using multimedia should include an awareness that the effect of 'new' multimedia may be short term. Development models should include the easiest ways possible of updating substantial parts of multimedia to include the newest and best material.

We increasingly have the need to prepare students not just with the ability to solve a given set of problems. They will need to gain the abilities to use new technologies to better understand what the problem is to start with, and then discover how to solve it. So its not sufficient to know the gas laws, we need to see in a situation that gas laws could solve an inherent problem. For instance global warming is currently much in the news, but how do you measure the temperature of the globe? If it is primarily the atmosphere then perhaps we can apply the gas laws to get our estimate. There is a sizable jump between being able to plug numbers into the gas laws and being able to estimate the global temperature using these laws and experimental data. Or to judge how good are the calculations done by experts.

If simply using new multimedia hardware and software gives a transient increase learning then we need to address how do we use multimedia to be most effective. Its use must be part of a larger thoroughly researched plan. One currently popular philosophy is constructivism.

> ...Constructivist curricula often emphasize group activities designed in part to facilitate the acquisition of collaborative skills of the sort that are often required within contemporary work environments. Such group activities may offer students of varying ages and ability levels, and having different interests and prior experience, the opportunity to teach each other a mode of interaction that has been found to offer significant benefits to both tutor and tutee. Explicit attention is also given to the cultivation of higher-order thinking skills, including "meta-level" learning the acquisition of knowledge about how to learn, and how to recognize and "debug" faulty mental models.
>
> ... the proposition that constructivist techniques, as currently understood, will in fact result in more favorable (in some sense) educational outcomes must still be regarded as largely (though not entirely) a collection of exciting and promising hypotheses that have yet to be rigorously confirmed through extensive, long-term, large-scale, carefully controlled experimentation involving representative student populations within actual schools. While the foundations of constructivism provide a rich source of plausible and theoretically compelling hypotheses, the fact remains that the question of how best to teach our children remains an empirical question that has not yet been fully answered. [2]

The combination of a constructivist method that may work well plus the effect of new technology which even if it is not more effective long term will give a boost in learning due to the 'Hawthorne" effect. Although preliminary research makes technology and constructivist approach look promising many questions remain.

> ... for careful research on the ways in which computing and networking technologies can be used to improve educational outcomes and the ratio of benefits to costs. The majority of the empirical research reported to date has focused on traditional, tutorial-based applications of computers. Several meta-analyses, each based on dozens of independent studies, have found that students using such technology significantly outperform those taught without the use of such systems, with the largest differences recorded for students of lower socioeconomic status, low-achievers, and those with certain special learning problems. While certain methodological and interpretive questions have been raised with respect to these results, the most significant issue may be the question of whether the variables being measured are in fact well correlated with the forms of learning many now feel are most important. [2]

Students who spend more time learning and solving problems in a given area generally do better on tests. In particular if you have created the material, such as a multimedia presentation, students using it have a better idea of what you consider important and what is likely to be on your test. A given use of multimedia or other technology may also give better results because it is new and interesting and students spend more time with it, not because it is more effective. Most of us will happily accept improved learning due to increased time spent on the material, but the multimedia will only be new for a short period of time. *If there is a truly more effective way of using multimedia -i.e., four hours spent using it shows more learning than four hours using usual methods then we have a more efficient, long term approach to learning.*

> ... Although some interesting and potentially promising empirical results have been reported in the literature, a substantial amount of well-designed experimental research will ultimately be required to obtain definitive, widely replicated results that shed light on the underlying sources of any positive effects, and which are sufficiently general to permit straightforward application within a wide range of realistic school environments.
> ... researchers, educators and software developers can be expected to develop content and techniques that optimize student performance with respect to whatever criteria are employed to measure educational attainment, progress within the field of educational technology will depend critically on the development of metrics capable of serving as appropriate and reliable proxies for desired educational outcomes.
>
> ... 1. Basic research in various learning-related disciplines (including cognitive and developmental psychology, neuroscience, artificial intelligence, and the interdisciplinary field of cognitive science) and fundamental work on various educationally relevant technologies (encompassing in particular various subdisciplines of the field of computer science).
>
> 2. Early-stage research aimed at developing innovative approaches to the application of technology in education which are unlikely to originate from within the private sector, but which could result in the development of new forms of educational software, content, and technology-enabled pedagogy, not only in science and mathematics (which

have thus far received the most attention), but in the language arts, social studies, creative arts, and other content areas.

3. Rigorous, well-controlled, peer-reviewed, large-scale (and at least for some studies, long-term), broadly applicable empirical studies designed to determine not whether computers can be effectively used within the school, but rather which approaches to the use of technology are in fact most effective and cost-effective in practice. [2]

Not just the technology but how to use the technology to make learning more effective.

...The Panel also believes, however, that a large-scale, rigorously controlled, federally sponsored program of research and evaluation will ultimately be necessary if the full potential of educational technology is to be realized in a cost-effective manner. Data gathered systematically by individual states, localities, school districts, and schools during an initial phase of federally supported educational technology efforts could prove invaluable in determining which approaches are in fact most effective and economically efficient, thus helping to maximize the ratio of benefits to costs in later phases. Federal funding will ultimately also be required for research aimed at analyzing and interpreting this data. [2]

The Teaching Web: A Guide to the World Wide Web for all Teachers
Ron Owston

... As we've just seen, there's plenty of evidence that the Web is a valuable means to increase access to education. Evidence on how it can promote improved learning is not as forthcoming. In fact, there's an ongoing debate in the instructional design research literature about whether there are any unique attributes of media that can promote improved learning. This debate stems from the observation that, after more than 50 years of research on instructional media, no consistent significant effects from any medium on learning have been demonstrated. [3]

Let's repeat that "after more than 50 years of research on instructional media, no consistent significant effects from any medium on learning have been demonstrated." I'm not sure what that means for multimedia, but it doesn't sound good.

... Some researchers go as far as to argue that no effect can possibly be demonstrated, because any improvement in learning that may accrue will come from the instructional design, not the medium that delivers
the instruction. [3]

Delivery of material on the Web does have some advantages, though not everyone will agree.

... there are at least three distinct learning advantages to Web use.
1. Web appeals to students' learning mode
2. Web provides for flexible learning
3. Web enables new kinds of learning

Let's look at some actual experiments. First what is available for helping in lecture? Casanova reports using a microcomputer to project lecture material for Organic Chemistry. Note in this experiment that both groups of students spent the same time in lecture, and were tested with the same exams. The difference was the type of presentation in the lecture.

"Students took very few notes, but listened and watched intently. Class participation (questions, comments, discussion) was high, of good quality, and stimulating. Students were very favorably impressed that they had a good understanding of the subject, particularly the visual representations of molecular structure. However, very poor performance on conventional examinations did not support this assertion. A control section (taught by Professor Stanley Pine) took all the same examinations on the same days as did the experimental section. There was a striking difference in result between the experimental section and the control section, with the experimental section performing more poorly in all categories of test items. The overall average in the course for students in the experimental section was 44%, contrasted with 63% for the control section."

Casanova, J.;"Computers in the Classroom- What Works What Doesn't"; Computers in Chemical Education Newsletter. 1996, Fall, **5-9.** [4]

What results in the best learning for our students? That we spend considerable time and effort making and using tools that may help them learn or spend the time directly with them in the more traditional methods? Of course it's not an all or nothing answer. Most of us don't have the time to go one on one with each student in person nor do we have time to become multimedia experts.

It is estimated by a number of implementors of multimedia in their lectures that a 4-6 times increase in preparation time is needed to make enriched materials. So the enriched material engaged students interest in lecture which is great, but the interest did not, in this experiment, translate into test measured learning. Plus there was a lot of time spent in developing the material.

> Engines of Inquiry: Asking the Right Questions: What Does Research Tell Us About Technology and Higher Learning?
> By Stephen C. Ehrmann, Annenberg/CPB Projects
>
> "I've got two pieces of bad news about that experimental English comp course where students used computer conferencing. First, over the course of the semester, the experimental group showed no progress in abilities to compose an essay. The second piece of bad news is that the control group, taught by traditional methods, showed no progress either."
>
> —from a talk by Professor Roxanne Hiltz at the New Jersey Institute of Technology on an early use of computer conferencing. [5]

Can we just assume that using technology such as multimedia is going to improve learning?

> ... they were asking whether a technology could be used to teach without specifying anything about the teaching methods involved.
>
> Richard Clark responded to that type of assertion by arguing, in effect, that the medium is not the message. Communications media and other technologies are so flexible that they do not dictate methods of teaching and learning. All the benefits attributed by previous research to "computers" or "video," Clark asserted, could be explained by the teaching methods they supported. Research, Clark said, should focus on specific teaching-learning methods, not on questions of media. [5]

Just as unlikely that technology is going to solve learning problems by itself so is the generalization that it doesn't matter what technology you use.

> ... Robert Kozma argues, for example, that the particular technology used is not irrelevant, but may be either well or poorly suited to support a specific teaching-learning method. There may indeed be a choice of technologies for carrying out a particular teaching task, he argues, but it isn't necessarily a large choice. There are several tools that can be used to turn a screw, but most tools can't do it, and some that can are better for the job than others. Kozma suggest that we do research on which technologies are best for supporting the best methods of teaching and learning. [5]

Why haven't individual disciplines found breakthrough programs that make a substantial contribution to learning?

> ...We wanted to understand why a few software packages had proved to be viable, while so many others were not. There are many reasons for this. Support services are often under-funded, so faculty can't be certain that the basic hardware and software will consistently be available and in working order. Changing a course involves shifting to unfamiliar materials, creating new types of assignments, and inventing new ways of assessing student learning. It's almost impossible for an isolated faculty member to find the time and resources not only to do all these things, but to take all these risks. Few institutions provide the resources and rewards for faculty to take such risks. For these and other reasons, the pace of curricular change is slow.
>
> We did discover a few small families of curricular software had found a niche. However, many of these packages gained use because they were familiar and inexpensive to develop (and thus inexpensive to update regularly). They got into use by being comfortable, not by making instructional waves. Hardly the stuff of revolution. [5]

Some of the best software is very general in nature.

> ..."Worldware" is the name we gave software that is developed for purposes other than instruction but also issued for teaching and learning. Word processors are worldware. So are computer-aided design packages. So are electronic mail and the Internet.
>
> Worldware packages are educationally valuable because they enable several important facets of instructional improvement. For example, on-line libraries and molecular modeling software can support experiential learning, while electronic mail, conferencing systems, and voice mail can support collaborative learning by non-residential students.
>
> Worldware packages are viable for many reasons: they are in demand for instruction because students know they need to learn to use them and to think with them; faculty already are familiar with them from their own work; vendors have a large enough market to earn the money for continual upgrades and relatively good product support; and new versions of worldware are usually compatible with old files, thus, faculty can gradually update and transform their courses year after year without last year's assignment becoming obsolete.
>
> For reasons like these, worldware often has proved to have great educational potential (value) and wide use for a long period of time (viability). Has that educational potential been realized in improved learning outcomes? There is no substitute for each

faculty member asking that question about his or her own students. Here are two such studies.

Individual uses for the general type of software make creation of specific materials for a class more practical.

> ... he used worldware to create an animation that enabled him to teach the same material (about a complex series of interactions in biochemistry) in half an hour. The students could also study the computer-based animation outside class, frame by frame if needed. "I was initially disappointed," he told me the day I visited him at Dartmouth, some months afterward. "There was very little excitement or discussion when I showed it in class. But later, when I gave them my regular exam on the subject, they did better than any previous class." [5]

Unfortunately this experiment left out many details such is how much did the students use the animation out of class? One disadvantage of writing your own material is that although it is creative to write your own software it is an enormous time investment and the results are limited. It takes much less time using a program you are familiar with and just use it.

> ... Thus, to make visible improvements in learning outcomes using technology, use that technology to enable large-scale changes in the methods and resources of learning. That usually requires hardware and software that faculty and students use repeatedly, with increasing sophistication and power. Single pieces of software, used for only a few hours, are unlikely to have much effect on graduates' lives or the cost-effectiveness of education (unless that single piece of software is somehow used to foster a much larger pattern of improved teaching).
>
> ... 1. Technology can enable important changes in curriculum, even when it has no curricular content itself. Worldware can be used, for example, to provoke active learning through work on complex projects, rethinking of assumptions, and discussion.
>
> 2. What matters most are educational strategies for using technology, strategies that can influence the student's total course of study.
>
> 3. If such strategies emerge from independent choices made by faculty members and students, the cumulative effect can be significant and yet still remain invisible. (Unfortunately, the converse can also be true. We may be convinced that we have implemented a new strategy of teaching across the curriculum, and yet be kidding ourselves.) As usual, there is no substitute for opening our eyes and looking. [5]

Stephen Ehrmann doesn't believe it is possible to have generalizations about how new technology works in all colleges He asks if it is more appropriate to set up tools for evaluating strategy we use with our own students. Find methods that seem to work in similar colleges, then customize for our own students. He also sees big effects not just from doing something in a given class, but how it expands when something like word processing or email are used college-wide.

> Ordinarily what matters most is: - not the technology per se but how it is used, - not so much what happens in the moments when the student is using the technology, but more how those uses promote larger improvements in the fabric of the student's education, and - not so much what we can discover about the average truth for education at all institutions but more what we can learn about our own degree programs and our own students. [5]

Few colleges have been willing to spend money to actually carry out evaluations of the effectiveness of using technology. There are many reasons for deciding not to do in depth evaluations. Not the least of is difficulty in making critical measurements in a fast changing environment.

- evaluation costs money and time,
- it may take months, even years, to develop a convincing picture and decisions are (always) pressing,
- changes in technology are so great that yesterday's investment in technology, no matter how successful or unsuccessful, can seem irrelevant to tomorrow's budget,
- and the possibility of meaningless or threatening findings, either of which might put the instigator at personal risk. [6]

For an opinion from Ewing at Yale Using Computers in Chemistry and Chemical Education

> Computer projection can add a great deal to the presentation of technical matter and is an aide to instruction. Besides being easily produced (once the software mastered!), computer graphics often are better at holding an audience's interest than are traditional presentations. Projection is suitable for the largest lecture halls, especially with multiple TV monitors. During preparation, graphic elements are easily stored and reused, changes are easily incorporated, and external resources (images, animations, or audio) may be added. Interactive operation, including network access adds dramatic value and richness to instruction and allows instructors to

adapt particular questions and problems that come up during class time.

... World Wide Web. The WWW, or "Web", offers another one-to-many communication channel. Faculty may create a set of Web pages on a Web server for class assignments or to provide needed information resources. Most Web browsing software (Netscape, Mosaic, etc.) has the advantage of handling images, animations, other types of data, and can provide a convenient "shell" (command entry system for access to other information services (FTP, gopher, telnet, news, etc.) At a sophisticated level, the Web may be used for forms-based data entry and secure transactions, which might include collecting homework, registering for sections giving exams.

... While few faculty are potential authors of multimedia textbooks, many could use the technology to prepare better lectures and materials for their own classes. Since computer software, such as Microsoft PowerPoint or Aldus Persuasion, is relatively easy to learn and inexpensive for still-projection images or to provide live media display. More elaborate tools, such as MacroMind Director or Adobe Premiere, are available for animation and video. Some faculty are writing Web pages and even using their personal computers as Web servers.

... The Automated Laboratory

The chemistry laboratory is increasingly dominated by computer-controlled instruments and digital data management, as described in other chapters. New opportunities for laboratories in education open up when laboratories are integrated with the campus computing environment. Primarily, this means giving labs full access to, and availability from, the campus data network. Lab students using personal computers or workstations can have access to information and computing resources to, for example, retrieve chemical data or literature, analyze molecular models,
perform reaction or process simulations on remote machines. [7]

From a chemistry instructor (Carolyn Sweeny)who worked with available programs.

... One of the programs depicts mechanisms in motion—a vast improvement over the printed page and much better than watching an instructor with waving arms attempting to show an SN2 mechanism. This software represents an excellent use of the computers provides explanations not possible on the printed page, and it doesn't grow tired as a teacher might making something move. None of the software used is very expensive some has come from the Internet freely dispensed. [8]

Russell and Kozma used a prototype multimedia computer program to teach some challenging concepts . Effectiveness was measured by giving a pretest to assess the students level and a posttest given after two lecture periods of using the computer program. Student responses were coded for content by a trained graduate assistant not involved in the design of the chemical content for this project. 34% of the students gave satisfactory answers on the pretest and 56% on the posttest. About 50% of the students showed serious misconceptions on the pretest, only 20% on the posttest.

A prototype multimedia computer program discussed below, Multimedia and Mental Models in Chemistry (4M:CHEM), utilizes modern technology to make the classroom more interactive, stimulating, and able to assist students in building accurate mental models for chemical concepts and phenomena. The 4M:CHEM software allows students to participate in selecting experiments to test or illustrate ideas, in selecting parameters for variables in experiments, and in selecting viewing modes for observing outcomes of experiments. Both qualitative and quantitative experiments are included to assist the student in building chemical understanding and intuition as well as developing quantitative problem solving abilities.

In summary, college students come into chemistry courses with an incomplete or inaccurate understanding about characteristics of chemical systems at equilibrium and about the influence of temperature and pressure on equilibrium. An initial assessment of 4M:CHEM in two lecture sections for two one-hour presentations showed an increase in students' understanding of characteristics of systems at equilibrium and the effects of temperature on these systems. [9]

Unfortunately they don't compare these results with those obtained by teaching similar students with traditional lecture methods. So learning occurred but it may be at the same rate as usual.

Roger Schank a longtime developer of multimedia feels the real potential and challenge is building systems that actively engage the user.

Most multimedia programs fail because they merely add video and graphics to page-turning programs. It does not matter whether that next page is text, graphics, or video, because the student is not doing anything. Consider remote-controlled television, which is a type of multimedia computer.

...Creating educationally effective multimedia programs taking seriously the idea of learning by doing. Good educational software is active, not passive, and ensures that users are doing, not simply watching.

...If we wish to profoundly change education, to make our schools better and our businesses more competitive, and we recognize the value of doing this through computers, we also need to understand what it means to create high-quality educational software. Our experience in building educational software for multimedia systems led us to formulate a number of principles about how to build educational environments in schools and in the workplace:

...Learn by doing. Learning should center on a task that requires the skills and knowledge we want to teach. The task should be challenging, but within a student's ability.

...Problems, then instruction. Students respond best to instruction when what they hear from the teacher relates to problems with which they are struggling. This method will teach students to associate the correct solution with a problem they may encounter in the future.

...Tell good stories. Students respond to compelling stories. Software must have good and timely cases that relate to students' problems.

...Power to the student. The student should control the educational process. The recommended path might be marked, but students should possess the power to determine or change the next step.

...The software is the test. Since the software we are talking about lets students do certain things or discover certain answers, the test is in whether the student demonstrates a new ability or makes a discovery.

...Find the fun. An instructional designer's job is to make learning fun, which means that students will enjoy what they are doing. If the instruction was designed correctly they will learn. [10]

Find the fun, a good thought to close with.

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10. Shank, R.;"Active Learning through Multimedia"; *IEEE Multimedia.*,**1994**, Spring, 69-78.

CALL FOR PAPERS FOR THE ANAHEIM ACS MEETING (SPRING, 1999)

Harry E. Pence
SUNY-Oneonta
pencehe@oneonta.edu

The following symposium is co-sponsored by the Divisions of Chemical Education and Computers, as well as the Committee on Computers in Chemical Education. It was not included in the early listing of symposia under the Chemical Education Division, but Dr. Parrill has asked me to indicate that she would be delighted to receive abstracts from readers of this Newsletter and other chemical educators. Please notice that, because the primary sponsor is the Computer Division, the deadline for submitting abstracts is Nov. 18, 1998, rather than the announced deadline for the Division of Chemical Education.

USING COMPUTERS TO FACILITATE LEARNING

This symposium will include two half-day sessions on the use of computers in chemical education. One session will include talks that discuss new computer-based learning tools for students and some evaluation of their impact on students. Talks appropriate for this first session may discuss hypermedia learning tools, intelligent tutoring tools or many other possible types of learning tools. The second session will include talks that discuss computerized tools that facilitate learning activities (which may or may not actually take place at a computer). Talks appropriate for this session may describe communication tools that facilitate collaborative learning, scheduling tools that allow faculty to include writing assignments in large classes, or tools designed to help faculty develop course content and/printer active materials to be delivered by computer. Please send abstracts to Abby L. Parrill, Department of Chemistry, University of Memphis, Memphis, TN 38152 by November 18th, 1998. Send electronic submissions toaparrill@memphis.edu.

MAY AND JUNE 1999 ON-LINE CONFERENCE

GENERAL PAPERS IN CHEMISTRY AND CHEMICAL EDUCATION

Papers on any aspect of chemistry and chemical education are being solicited for an on-line conference which will be held during May and June of 1999. Those who are interested in submitting a paper should contact:

Donald Rosenthal	or	Brian Tissue
Department of Chemistry		Department of Chemistry
Clarkson University		VPI & State University
Potsdam NY 13699		Blacksburg VA 24061
rosen@clvm.clarkson.edu		tissue@vt.edu

SOME INFORMATION FOR AUTHORS

Papers are expected to be the equivalent to at least ten typewritten pages in length.

February 1, 1999 - DEADLINE for receipt of titles and abstracts

April 1, 1999 - DEADLINE for receipt of final papers in HTML or ASCII format.

The conference is free to all Internet users.

Those who are interested in obtaining more information may subscribe to the CONFCHEM Listserv or the website.

To subscribe send the message:
SUBSCRIBE CONFCHEM your-first-and-last-name
To: LISTSERV@CLVM.CLARKSON.EDU

Brian Tissue (tissue@vt.edu) is managing the CONFCHEM World Wide Web site:http://www.chem.vt.edu/confchem/

Also, additional information may be obtained by contacting either Donald Rosenthal or Brian Tissue.

SEPTEMBER 1999 ON-LINE CONFCHEM

WHAT SHOULD STUDENTS KNOW WHEN THEY LEAVE GENERAL CHEMISTRY?

Organized and moderated by:

Professor Paul B. Kelter
Department of Chemistry
University of Nebraska
Lincoln NE 68588
pkelter@unlinfo.unl.edu

Five papers will be presented by invited speakers.

General chemistry is a course that serves a vast and diverse student audience. Deciding what students need to know upon finishing the course is difficult because the audience is so varied. For example, how are the needs of pre-medical and pre-health students different from those of agriculture majors? What does the chemical industry think that students ought to know? What is needed for the one-semester vs. two-semester course? How do faculty define a student "need" vs. a faculty "preference" in the curriculum? What are some creative ways of dealing with diverse needs?

The CONFCHEM Listserv and Website will be used for this session.

JULY 1999 ON-LINE CONFERENCE

DISTANCE AND COLLABORATIVE EDUCATION USING THE INTERNET

There will be a focused five paper session after the May and June general session. The session will last from Monday, July 5 through Friday, August 6, 1999 and the tentative list of presenters is:

Doris Kimbrough, CU-Denver - Distance education for non-traditional students
Carl Snyder, Univ. Miami - An Innocent Tries Distance Education
Lindy Harrision, York College - On-line chemistry courses (OLCC)
Deborah Sauder, Hood College and Marcy Hamby Towns, Ball State University - Physical Chemistry On-Line (PCOL)
Joe Merola, Assoc. Dean for Research and Outreach, Va Tech - "The (cursed) administrator's viewpoint"

The conference is free to all Internet users. More information will be posted on the CONFCHEM website: http://www.chem.vt.edu/confchem/

or can be obtained from the session organizer:

Brian Tissue
Department of Chemistry
VPI & State University
Blacksburg VA 24061-0212
tissue@vt.edu

Computer-Based Facilitation of Pedagogically Valuable Learning Activities in Large Classrooms

Abby L. Parrill
aparrill@memphis.edu
University of Memphis

The presence of large classrooms in our universities is a reality that is not likely to change in the near future. Large classrooms unfortunately deter educators from using the broad variety of pedagogically valuable learning activities that have been reported in the educational literature. Examples of valuable learning activities that are challenging to incorporate into large class formats include collaborative (group) learning, writing assignments, guided-inquiry, interactive class discussions, portfolio-based assessments, and group projects. This article describes several ways in which computers can be utilized to facilitate the incorporation of some of these activities into large classrooms.

<u>Writing Assignments in Large Classrooms: Select-A-Due date</u>

The value of writing has long been recognized as evidenced by the fact that institutions of higher learning have 'writing across the curriculum' requirements. One deterrent to the incorporation of writing assignments in large classes is the time-consuming nature of grading such assignments. I have utilized a web-based form to allow students to register for due dates distributed throughout the semester to facilitate the grading of writing assignments in large enrollment courses. The web-based form collects name, student identification number, first choice of due date, and second choice of due date. This information is sent to a CGI-script (written in the Perl scripting language) that checks to see if the maximum number of registrants for the first due date choice has been reached. If the maximum enrollment has not been reached, the student is given their first due date choice. Otherwise the script checks their second choice. If their second choice already has maximum enrollment, the student is unfortunately given their least preferred due date. This possibility does provide some incentive for registering early. The web-based form and the CGI-script will be provided via email to anyone interested in them.

Group Projects in Large Classrooms: Online Group Discussion Pages

One common student gripe about group projects is their inability to find common meeting times. The use of computer-based discussion pages can assist students to hold asynchronous meetings and discussions. Several mechanisms exist for implementing online discussions among groups of students. Electronic mail can be used, either through the use of group mailing lists or listservs. A newsgroup-like system would also provide a discussion mechanism, with the added benefit of maintaining an archive of postings. I have utilized the group functionality designed into the *LectureOnline* course development and delivery system developed at Michigan State University by Gerd Kortemeyer (kortemeyer@nscl.msu.edu). This system allows course instructors to design web-based courses or course supplements, to develop semi-individualized homework assignments, and (most important to this topic) to organize students into groups. Each group can access group pages for any group to which they are assigned and post notes to other members of their group. Instructors can access the group pages for all groups. Instructor access to project discussions can assist in the evaluation of contributions by various group members. This provides instructors a good mechanism for dealing with another common student concern, distribution of work in group projects.

The two examples in this article should demonstrate that computer use in instruction need not be limited to educational tools for students. Computers also provide capabilities to facilitate classroom activities and assessment.

A Sunscreen Experiment Using the World Wide Web and Molecular Modeling

David M. Whisnant
Wofford College
429 N. Church St.
Spartanburg, SC 29303-3663
whisnantdm@wofford.edu

Recently Dick Cornelius and coworkers[1] published an experiment in which students measure the UV spectra of commercial sunscreens and use molecular modeling to predict the electronic spectra of compounds used in sunscreens. We have incorporated Cornelius's experiment into a longer discovery-based laboratory project that introduces students to organic chemistry and spectroscopy, molecular modeling, and search engines available on the World Wide Web. One of the aims of this project is to give students experience with the computational and information-gathering tools that are now available with powerful desktop computers and modern networks. At the same time, we want them to realize that the results of computations or Web searches should not be blindly accepted just because they appear on the computer screen. Some sort of evaluation always is necessary.

The four-week long project begins by introducing the students to organic compounds and functional groups in a short lecture at the beginning of the first laboratory period. After the introduction, groups of three or four students are given infrared spectra of several simple organic compounds and discover the IR peaks that are characteristic of different functional groups. They also measure the visible-UV spectra of six organic compounds and discover the characteristics of the structures of compounds that absorb visible and ultraviolet radiation. In the last part of this experiment they use this information to help them identify compounds. They record the IR spectrum of an unknown and choose the most likely structure for the unknown from a list which we supply. They also match structures of three compounds, one of which is aromatic and one of which is conjugated, with their real-world applications as components of sunscreens, lipstick, and perfume (the latter by default when the other two have been identified).

In the second week of the project, the groups measure the UV spectra of commercial sunscreens with different SPF values, which we use to construct a standard curve so that the SPF of an unknown sunscreen can be estimated[1]. The groups then design a new compound that they expect to be a good sunscreen. As they work on their new compound we ask them to think about the structures of known sunscreens, the general rules they have learned for constructing organic structures, and the relationship between polarity and water solubility.

One of the objectives of this project is to have students write individual formal reports based on their own experiments and on information accumulated by the class as a whole. This information is shared by posting it on a Sunscreen and Ultraviolet Radiation Web site that I maintain (http://www.wofford.edu/~whisnantdm/sun_uv98.htm). At the end of the second week's laboratory, the groups turn in their experimental spectra and the structures of their proposed sunscreens, which I incorporate into pages on the project Web site. During the third week, in lieu of their regularly scheduled laboratory, individual students search the Web for information on sunscreens, ultraviolet radiation, stratospheric ozone depletion, and related topics. Most students have had experience with the WWW, but few have used search engines with a Boolean search structure. To help students who haven't had experience with advanced searches, we distribute a handout describing how to use HotBot and Alta Vista. Because Web sites are not peer-reviewed, the quality of information on the Web is variable, to say the least. This handout also suggests strategies that students can use to help evaluate information from the Web for credibility and reliability[2] http://www.sccu.edu/faculty/R_Harris/evalu8it.htm. Each student is asked to turn in the titles and URLs of three good web sites by the end of the week. After testing, links to these URLs are posted to the project Web site.

During the final week of the project, the students use Quantum CAChe, running on 266 MHz Pentium II computers, to model their compound. They optimize the structures of their proposed sunscreens using molecular mechanics and then predict the electronic spectra using ZINDO. Each group copies their predicted spectrum to a paint program and then saves it as a .jpg file suitable for posting on the WWW. I add the spectra to the project Web pages that already contain names of the students in the groups and the structures of their proposed sunscreen. I also post ZINDO spectra from CAChe calculations for four common components of sunscreens along with wavelengths of peaks from experimental spectra [1]. These can be compared to give the students an idea of the reliability of the ZINDO predictions.

At the end of the project the students write formal laboratory reports. To put the experiments in a larger context, the students are asked to include a discussion of ultraviolet radiation, health effects, the ozone layer, and classes of sunscreen in their introduction. Other then some leading questions in the project handout, we give the class no written information on these topics. The URLs found by the class and linked to the project Web page furnish more than enough information to write this introduction. In their report the students also discuss their experimental work, the expected quality of the CAChe UV spectrum predictions, how good a sunscreen their proposed compound would appear to be based on the molecular modeling results, and which of the compounds proposed by the class they would expect to be the best sunscreen.

[1]C. Walters, A. Keeney, C. T. Wigal, C. R. Johnson, and R. D. Cornelius, *J. Chem. Educ.* **1997**, *74*, 99.
[2]Harris, R. (1997). *Evaluating Internet Research Sources*, [Online]. Available:

Integrating Computational Chemistry and Molecular Modeling into the Undergraduate Chemistry Curriculum.

A Symposium Report

Harry E. Pence
SUNY Oneonta
pencehe@oneonta.edu

At the spring, 1998 meeting of the American Chemical Society in Dallas, Texas, the Committee on Computers in Chemical Education sponsored a symposium entitled, "Integrating Computational Chemistry and Molecular Modeling into the Undergraduate Chemistry Curriculum." The following description is intended to briefly review that symposium(with apologies to the various presenters for compressing their papers so much).

Molecular modeling and computational chemistry have become standard tools for many industrial and synthetic chemists. The decrease in the price of computer hardware and software has made it increasingly possible to include this type of material in the undergraduate program, but it is not yet clear how this material can best be integrated into an already crowded curriculum. Thus, it was not surprising that a wide variety of different approaches are in use by the institutions represented at this symposium.

Many of the papers described efforts to introduce molecular modeling into existing courses. For example, both the University of Northern Colorado (Greeley, CO) and Clarke College (Dubuque, IA) use molecular modeling in the general chemistry course. Texas A & M University (College Station, TX) teaches molecular modeling in the introductory organic labs, and the University of Hartford (West Hartford, CT) teaches this material in an upper-level synthesis course. On the other hand, Lebanon Valley College (Annville, PA) incorporates molecular modeling into all levels of the curriculum through the laboratory work.

The same diversity was found among the schools that are introducing computational chemistry. The University of Michigan (Ann Arbor, MI) has added computational chemistry into several courses in its curriculum, but especially the Structured Study Groups, that are the basis of the Honors section of the undergraduate Structure and Reactivity course. Michigan State University also has been merging computational chemistry into existing courses and is developing an undergraduate specialization in computational chemistry.

The University of St. Thomas (Houston, TX) introduces computational techniques to students in the physical chemistry course, by doing normal mode analysis. Rather than attempting to integrate computational chemistry into existing courses, Valdosta State University (Valdosta, GA)is developing a new required course.

The symposium also included some industrial representatives. The Wavefunction Corp. (Irving, CA), well known for its modeling software, has developed a workbook with experiments and demonstrations for use inorganic courses, and a speaker from SUNY Oswego demonstrated a new, inexpensive molecular modeling program.

Many of the questions during the discussion concerned what level of the curriculum was best for introducing these sophisticated topics. Some speakers felt it was better to delay until students had enough background to fully understand what they were doing, whereas others proposed to introduce the material early in the curriculum, so that students would become familiar with these methods early in their chemical careers.

These symposia papers, and the discussion that accompanied them, raise some fundamental questions about the way that we teach chemistry. The argument that we should not teach advanced techniques, like computational chemistry and molecular modeling, until students have the mathematical background and maturity to better understand them, is both reasonable and attractive. The opposing arguments are, however, also very compelling.

It has become traditional to teach chemistry in a recursive manner, that is, to return to the same topic at different levels of the curriculum in increasing levels of detail. Perhaps the best example here is atomic structure. Very few students really understand the orbital diagrams in general chemistry, but these experiences lay the groundwork for a more in-depth treatment in physical chemistry and other advanced courses. Should a similar approach be used with molecular modeling?

General chemistry, and even organic, are mainly service courses, where students majoring in other sciences pick up enough modern chemistry to serve as a basis for their majors. Since these students don't normally take advanced chemistry courses, can we overlook the possibility to introduce them to molecular modeling, one of the most powerful tools of modern chemistry?

The discussion in this symposium clearly has ramifications far beyond a single scientific meeting. These opposing viewpoints will continue to be expanded and debated. This symposium represents a early step in what will surely become a more extensive dialogue in the years ahead.

Why Use Presentation Software?

Harry E. Pence
SUNY Oneonta, Oneonta, NY
pencehe@oneonta.edu

Over the past several months, Brian Pankuch and I have exchanged several e-mails about the ways to use presentation software, such as PowerPoint, more effectively. Growing out of those conversations, this is the first of what may become a series of short articles, intended to share the results of my own efforts to find better ways to utilize this technology. Of course, it should be read with the usual disclaimers that the opinions expressed are solely my own and that alternative viewpoints will be welcomed.

Despite the rising popularity of presentation software, thus far there has been mixed evidence that it really improves learning. This shouldn't be a surprise. The software was originally developed for sales presentations, and it has been in use a relatively short time for teaching. The main weakness of the product may well be that it is much easier to master the technology itself than it is to discover the pedagogy that will create the best learning environment.

One of the great advantages of presentation software is that it allows an instructor to combine text and images in a single frame. In the past it was all but impossible for a professor to do this without extensive preparation and cost. Psychological research indicates that the juxtaposition of text and images is an effective educational technique, and my students certainly report that the combination of concepts with a related image helps them to remember the material better.

The use of images is particularly valuable for chemists, since a common problem encountered in chemistry teaching is the difficulty students have relating the microscopic world of atoms and molecules to the macroscopic world, which is directly available to the senses. When I ask students what types of pictures are most useful to them, molecular images are invariably the first choice. Molecular images apparently convert an abstract concept into a form that they feel is easier for them to visualize.

The students become deeply involved in the visuals. Events and processes that were formerly difficult to make interesting now come to life, especially the historical references that many faculty love to use. When I talk about poison gas in World War I or the burning of the Hindenburg, I can show the students pictures of the actual events. Students are very responsive to these images. Perhaps the result is best described by quoting what one of my students said on an anonymous survey, "With the computer, the concepts become real. They aren't just notes on a piece of paper. You actually prove that things happen and we just don't have to accept what you tell us."

Whatever the reasons, when presentation software is used well, students report that they very strongly prefer it to other teaching methods, like blackboard or overhead presentations. These favorable results do require, however, that the images be carefully chosen to relate to the concepts being discussed and also that the students be encouraged to make these associations. I have been using a combination of presentation software and cooperative learning for several years and have found that these two techniques are an excellent combination.

What types of images are best? Although the students indicate that all types of images are useful, molecular images are rated highest. Historical images are usually rated lowest, both for interest as well as usefulness. As might be expected, movies create a particularly strong impression. The most difficult part is to select images that are directly related to the concepts being presented. It is a temptation to include "cute" images, especially since most software packages provide a selection of clip art. At best this may represent an opportunity to add some humor to a dry lecture; more often, it is a missed opportunity to clarify and illustrate the text on the frame.

The cardinal rule when using presentation software must be, "Don't rush!" Don't go on to the next frame until the students have had sufficient time to complete their notes. My surveys suggest that many of the students prefer to a rough sketch of the images in their notes. They have recognized that this is a valid learning technique. As teachers, we need to support this behavior, not make it more difficult.

Next installment: Capturing the students eyes.

CALL FOR PAPERS

The Northeast Regional Meeting, June 21-25, 1999, Clarkson University, Potsdam NY. Submit abstracts of papers or posters to: Donald Rosenthal, Department of Chemistry, Clarkson University, Potsdam NY 13699-5810, Phone: 315-268-2352, E-mail: ROSEN@CLVM.CLARKSON.EDU. See the NERM website: http://orthanc.sc.clarkson.edu//~acsnorth/nerm99/ for information about symposia, general paper sessions, workshops, etc.

SEPTEMBER 1999 ON-LINE CONFCHEM

WHAT SHOULD STUDENTS KNOW WHEN THEY LEAVE GENERAL CHEMISTRY?

Organized and moderated by:

Professor Paul B. Kelter
Department of Chemistry
University of Nebraska
Lincoln NE 68588
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Five papers will be presented by invited speakers.

General chemistry is a course that serves a vast and diverse student audience. Deciding what students need to know upon finishing the course is difficult because the audience is so varied. For example, how are the needs of pre-medical and pre-health students different from those of agriculture majors? What does the chemical industry think that students ought to know? What is needed for the one-semester vs. two-semester course? How do faculty define a student "need" vs. a faculty "preference" in the curriculum? What are some creative ways of dealing with diverse needs?

The CONFCHEM Listserv and Website will be used for this session.

PROPOSALS FOR CHANGE IN THE INTRODUCTORY CHEMISTRY COURSE

An On-Line Session - March 29 to April 10, 1999

Chaired by: J.N. Spencer
Chemistry Department
Franklin Marshall College
Lancaster PA 17604
Fax: 717-291-4343
Phone: 717-291-3807
E-mail: j_spencer@acad.fandm.edu

An on-line conference will involve over 800 participants focusing on "Proposals for Change in the Introductory Chemistry Course". While both process and content need to be considered, content is often stressed to the detriment of process. Changing just one or the other will not result in the best learning experience for students. Only if content and process are seen to be mutually inclusive will the full potential for educating our citizens be realized. This conference, however, will be limited to a discussion of content. If we can begin to examine the current content and how and why certain topics came to be considered as essential for the course, we may be able to approach a common curriculum so that the process of how to best implement it may then be developed.

Stephen J. Hawkes of Oregon State University compiled suggestions for the content of general chemistry. He served as leader of the Zero Base Course discussion group for the Task Force on the General Chemistry Curriculum. The goal of the zero base approach is a detailed curriculum in which topics are developed so that students understand the phenomena considered necessary for the course. This analysis requires that the principles that should be in the course be identified, that those not necessary be removed, and perhaps additional principles be added. This on-line conference will list 127 proposals compiled from many viewpoints (not necessarily those of the Task Force). Proposals are worded as debatable propostions to engender serious discussion. After discussion, amendment, deletion, extension, and some consensus, the proposals will be distributed to the chemistry community in various forms. Future discussions are also planned.

The March and April session is free to all Internet users. Those who are interested in obtaining more information may subscribe to the CONFCHEM LIstserv or access the website.

To subscribe to the CONFCHEM Listserv send the message: SUBSCRIBE CONFCHEM your-first-and-last-name To: LISTSERV@CLVM.CLARKSON.EDU

The CONFCHEM World Wide Web site has the URL: http://www.chem.vt.edu/confchem/

A Simple Strategy for Creating Web-based, Interactive, Multiple- Choice, Practice Examinations.

Carl H. Snyder, Chemistry Department,
University of Miami, CoralGables FL 33124
CSnyder@miami.edu

INTRODUCTION

This article describes a simple, text-based HTML technique for creating multiple-choice Web examinations that allow students to review course materials interactively. Clicking on any of the answers to each examination question reveals whether that answer is right or wrong. The technique is particularly useful in converting class examinations into Web-based practice examinations.(1)

(1) Examples of examinations created through this approach are available at www.miami.edu/chm/chm201a2 (organic) and www.miami.edu/chm/chm101h (nonmajors). Look for File Examinations on the home page. These should be available through 15 December 1998.

The principal advantage of this strategy is simplicity. It requires only the ability to write HTML coding, or access to a fully featured Web page-creation program. Except for graphic, audio, or other binary files that might be included within the examination- or response-files, all files are text (ASCII) based. Other than competence with HTML, no programming skills are required.(2)

(2) Among many books available for introductions to and compendia of HTML coding, I have found Laura Lemay's HTML books especially useful, e.g. "Teach Yourself Web Publishing With HTML 4 In A Week", 4th Edition, Laura Lemay, Sams.net Publishing, 1997. See also http://www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimerAll.html

In practice, an HTML-coded file is created for the multiple- choice examination and is placed in a server directory along with a set of five HTML files (for 5-choice questions) that respond to wrong answers and a set of HTML files, one for each question in the examination, that respond to right answers.

In order of increasing complexity, the following illustrate 1) a typical wrong-response file, 2) a typical right-response file, and 3) a typical question taken from a quiz-file.

WRONG-RESPONSE FILE

Sorry, but that is the wrong answer. Please use your browser to move back to the quiz and try again.

That's the entire text for the wrong-response file. Except for HTML emphasis on the word "wrong" it contains nothing fancy. It seems desirable to keep the wrong-responses low key. The student now uses the browser's own capabilities to return to the the same location on the previous page, the examination page, and try the question again. There is no return-to-test link in the wrong-response file to carry the student back to the test question just attempted. The browser itself performs this function. This method of operation allows one set of five wrong-response files to be used for the entire examination.

The wrong-response files are named no1.htm through no5.htm. Alternatively they might be no_a.htm through no_e.htm, or some other variation. The file no1.htm is linked to each *wrong* choice *a)* in every question within the examination; file no2.htm is linked to each *wrong* choice *b)* in every examination question, etc. For *right* choices *a)*, *b)*, etc., there is a set of right-response files.

RIGHT-RESPONSE FILE

Yes! That is the <blink>RIGHT</blink> answer. Now move to the next question.

Here HTML coding is used for font color, font size, and to produce blinking of the word "right". Effects can easily move up or down the scale, depending on the complexity desired for right- response files, HTML competence, and/or the sophistication of a Web page-creation program.

The coding <a href="quiz.htm#03"> carries the student back to the examination, which is in a file named quiz.htm, and to the next question. This implies that the right-response file shown above must be the file for the right answer to question #2, and is used *only* for that particular answer of that particular question. Thus each right-response file must contain a <a href="quiz.htm#nn"> where #nn refers to the next question in the examination. (The right-response file for the final question carries the student to links that permit return to question #1 for repeating the examination or back to the home page, as described below.)

Each right-response statement is the sole occupant of a unique html file, named no01.htm, no02.htm, etc., or an appropriate variation. Notice that for the first five questions, the wrong- and right-response HTML files are distinguished from each other by a single digit (1, 2, etc.) for the wrong- and two digits (01 02, etc.) for the right-response. All additional questions continue to use two-digit right-response files, no06.htm, no07.htm, etc.

QUIZ FILE

Questions

```
<a name="06">06.</a> The energy of the sun comes from:
<ul>
<li><a href="no06.htm">a)</a> fusion of H nuclei to form He nuclei
<li><a href="no2.htm">b)</a> fission of He nuclei to form H nuclei
<li><a href="no3.htm">c)</a> fission of U-238 nuclei
<li><a href="no4.htm">d)</a> fission of U-235 nuclei
<li><a href="no5.htm">e)</a> fusion of deuterium and tritium nuclei
</ul>
```

The question starts with an HTML name. In this question, Question 06, the <a name="06"> is the target of the right- response file for question #05. This is what brings the browser back to question 06 of the quiz.htm file when the student clicks at the return-to-quiz link of the right-response file for Question 05.

The five choices are coded as an unnumbered list. Response *a)*, the correct response in this case, is coded to take the student to the right-response file for this question, no06.htm; all others are coded for one of the five wrong-response files.

A typical quiz footer:

```
<hr>
<a name="51">= THE END =</a><br> You now have the choice of:
<ul>
<li>returning to <a href="quiz.htm#01">Question #01</a> to repeat the quiz, or
<li>returning to the <a href="../101hfile.htm">file examination menu</a><br>
</ul>
</body>
</html>
```

Following a hard rule <hr>, a section named "51" (for a 50- question examination) gives students the options of returning to Question 01 of the examination or returning to a menu of file examinations. This footer must be coded <a name="[nn+1]"> where nn is the number of the last question on the examination.

Every quiz file is named quiz.htm. Multiple quizzes are distinguished from each other by the names of their storage directories.

Link colors:

Placing the code <body link="#228B22" vlink="#228B22"> early in the quiz file prevents the browser from changing the colors of the links as they are clicked. Thus good choices made by the first student to take the quiz don't reveal the right answers to subsequent students (using the same computer) through color changes in links.

OTHER CONSIDERATIONS

The simplicity of HTML coding requires that every examination file, together with all its right- and wrong-response files, be placed in a unique directory on a server. The entire set of both right- and wrong-response files must be placed in every directory containing a quiz. This approach is demanding of server space, but that is a cost of its simplicity.

As with any other html document, graphics such as .gif or .jpg files can be inserted into the right- and wrong-response and quiz files. For rapid downloading via modems, I avoid graphic and other binary files except where graphics are integral parts of the questions.

Although beyond the scope of this discussion, the use of word- processor macros facilitates immensely the conversion of classroom examinations into these HTML quizzes Anyone interested in copies of the macros I have written for use with my DOS-based, WordPerfect 5.1+ word processor may contact me. With these or other macros, the only time-consuming activity, other than proofreading, is identifying correct answers and entering the appropriate right-answer code by hand.

Finally, the HTML coding described here is effective with the currently available Netscape Communicator. While other browsers, or later versions of this browser, may require (or benefit from) different coding, the strategy described here should be generally and consistently useful.

COMPUTERS IN CHEMICAL EDUCATION NEWSLETTER

SUBSCRIPTION AND RENEWAL FORM

Fill out this form and return it with your remittance to:

Dr. Donald Rosenthal
CCE Newsletter
Department of Chemistry
Clarkson University
Potsdam NY 13699-5810

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Department of Chemistry
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Donald Rosenthal, Consulting Editor
Department of Chemistry
Clarkson University
Potsdam, NY 13699-5810