Programming Method	Typical Use
client-side image maps	navigation, graphical practice exercises
server-side image maps	navigation, graphical exercises that logs user answers
CGI	multiple-choice or calculational exercises that access databases or log user answers
JavaScript	multiple-choice or calculational practice exercises, easy to interface form elements and clickable image maps on a Web page
Java	stand-alone presentations or tutorials

This article has attempted to present an overview of Web programming methods. There are a number of other software tools for visualizing and manipulating objects and data that were not discussed in this article. A couple of noticable ones for education are the Shockwave plug-in that allows Macromedia Director, Authorware, and Freehand files to be viewed from a browser window, and Mathcad 6.0 or Mathbrowser for viewing mathcad worksheets.

- Macromedia: Shockwave Center, http://www.macromedia.com/shockwave/.
- Mathcad 6.0 Animation Gallery, http://www.mathsoft.com/60dir/animatio.htm.
- Mathbrowser Home Page, http://www.mathsoft.com/browser/index.html.

References

Note: all URLs listed in this article were verified 9/16/96.

[1] A good starting point to find programming and Web tools is: Yahoo! - Computers and Internet:Internet:World Wide Web, http://www.yahoo.com/Computers_and_Internet/Internet/World_Wide_Web/.

[2] Not to be confused with a server-side version of JavaScript, which is under development.

[3] Mark. C. Reynolds and Andrew Wooldridge, Special Edition Using JavaScript (Que, Indianapolis, IN, 1996); ISBN: 0-7897-0789-6.

[4] Aaron Weiss and Scott J. Walter, The Complete Idiotís Guide to JavaScript (Que, Indianapolis, IN, 1996); ISBN: 0-7897-0798-5.

[5] Till, D. Teach Yourself PERL in 21 Days; Sams Publishing: Indianapolis, IN, 1995.

[6] There are lots of books on Java (and the other topics in this article). O'Reilly sells several Java books at several levels of expertise; see: Java, http://www.ora.com/catalog/java.html.

[7] JavaScript is also at an early stage of development, but uses less rigorous variable typing and is therefore more forgiving for imperfect program code.

"Some Reflections On the Intercollegiate On-Line Course: Industrial and Environmental Chemistry"

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In this article I would like to take some time to reflect on the On-Line Chemistry Course which was taught last Spring. I am not going to dwell too much on the mechanical details of the course, as Don Rosenthal did an admirable job of that in his article in the Spring 1996 issue (pp. 16-20). I will express some of my observations about the course.

The organizing committee began its work in January of 1995, a full year before the course began. I would like to thank the committee (George Long, Don Rosenthal, Maria Pacheco, Reed Howald, and Carl Snyder) because I could not have organized this course without them. During this year a considerable amount of work took place. I wasn't sure at the time we could complete the preparations for the course, but we did. In the end there were 20 schools and 96 students which turned out to be about the right number. My thanks again to all those instructors and the authors whose commitment made this course a success.

After all of the thousands of pages of email and the countless hours of studying, guiding and reviewing, what

have we learned?
First of all I think we found that this approach to learning definitely has its place. The comments were generally good whether they were from instructors, students, or the authors. The students became more independent and learned how to grapple with ideas where the answers were not as clear as one would like.

The course topic is critical. An on-line course is not an easy way to get purely factual type information across. The traditional educational settings seem to handle this type of info reasonably well. The subject studied needs to have some element of controversy in it. This allows for a two way discussion between the students and the author. It allows for dialogue between a student and the author to examine controversial ideas on a deeper basis. Much factual chemistry is still taught, but it is shared within the framework of the broader discussion.

Can the traditional subject be handled via this format? Yes, but you need to be able to expend a considerable amount of effort to draw the students out as Theresa Zielinski did in our trial run of the course in the Fall of 1995. The biggest challenge, no matter what the subject, is to engage the students in dialogue by thinking through the issues, the subject, and the concepts together. In the process they learn. It should not be a case of the student asking a question and then sitting passively while receiving the answer from the expert.

There were some passive learners in the group and for them I am not sure how much of an advantage this course would be over a regular course other than hearing from three experts in their fields. The greatest learning experience probably came to those who wrote and defended the two student papers.

Part of the design of the course was to have groups of 3-7 students write papers on subjects related to industrial and environmental chemistry. Most professors either required or encouraged their students to participate. A committee then selected two of these papers for discussion by the entire on-line course.

The students in the two groups which had to defend papers learned a great deal very quickly. With roughly ninety students firing questions, accurate and rapid answers are called for. Although it was not practical, it would have been nice if every student had been involved in defending a paper. Explaining and defending ideas to others is one of the best ways to learn.
One practical problem which we had with the course was the early deadline for submission of the papers. The on-line portion of the course started on February 5 and the deadline for submission was February 26. Although some schools started classes well before February 5, at least one school didn't start until February 6. This gave very little time for the submission of a major paper. Given that we needed to be ready to discuss paper 4 by March 18, it seems difficult to imagine that a much later deadline would have been reasonable. In spite of the short time frame ten paper were submitted by the deadline. These were all solid papers and some were excellent presentations. These papers can still be obtained from the course web-site at <http://dirac.py.iup.edu/college/chemistry/chem-course/webpage.html>.

A problem for the students and many of the faculty members was the large volume of email. This seems to me to be an unavoidable side effect of the course. There needs to be a certain level of email activity to generate the discussion level needed in the course. By luck perhaps, we managed to reach about the right level. However, students are not used to this level of email activity. Instructors need to teach students how to sift through the large volume of email.

There are some clear advantages to this approach to chemistry education. First, it allows expert authors to be made available to a small class and/or small school. Recruiting Dr. Trehy, Mr. Seelig, and Dr. Armor was possible because of the combined size of the operation, but would not have been possible for most of the individual classes.

The course provided the students with an opportunity to interact with the authors as opposed to just reading their material which is the case with text books. This was an opportunity not often granted to students. In addition the students were given a unique exposure to a large number of their peers. These experiences gave the students a broad perspective which they could not have had otherwise.

If you are interested in being involved in a course like this in the future, please contact Don Rosenthal at <rosen@clvm.clarkson.edu>. If you want to learn more about the spring semester 1996 course visit the website given above. There appears to be interest in another course like this one. The success of the course was a tribute to team work. A course such as this cannot succeed without the generous cooperation of many people. I wish to thank all those who helped to make the 1996 course a success.