Continuing to Teaching Chemistry Students, Still Using Blackboard and Flash for "e-education"

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Before you begin here, if you have time, take a quick look at two previous Computer in Chemical Education articles I've done: the first in fall 2001 and the second is fall 2002. They cover authoring computer-based animations and using the server-based software Blackboard to teach chemistry in a predominately undergraduate environment.

This first part of this article deals with my continuing evolution of the use of on-line support for freshman chemistry courses at Sam Houston State University a predominantly undergraduate institution. We have an ACS-certified BS in chemistry and an MS degree in chemistry.

The second part that you will find here will cover my recent experimentation with Shockwave flash animations specifically programmed to require student interactions with the animations. I use these in teaching chemistry at the senior level in an instrumental analysis course. Links to examples are provided.

as teachers we're evolving

In the past ten years I have evolved from a user of FTP-based server delivery of important laboratory data documents to a web-based supply of lecture syllabuses, Flash-based animations, lecture course documents, and practice quizzes. The continuing evolution of Course Management Software (CMS) like Blackboard, WebCT, etc. has substantially changed what we can choose to do in the chemistry classroom. (A very recent rumor is that Blackboard and WebCT have merged.) The key word here is choose because many of my colleagues have either not looked at what's possible or have only used it only minimally, or not at all. These are, in the main, dedicated teachers who, like all good teachers are kings and queens of efficiencies. They evaluate, continuously, things that will help them meet their idea of what they need to teach and in how they need to teach it. I do that; they do that; teachers in 1954 were doing that. The question is how modern, server-based software can increase our efficiencies. That's what I'd like to comment on in this communication.

Blackboard 6 Login Page
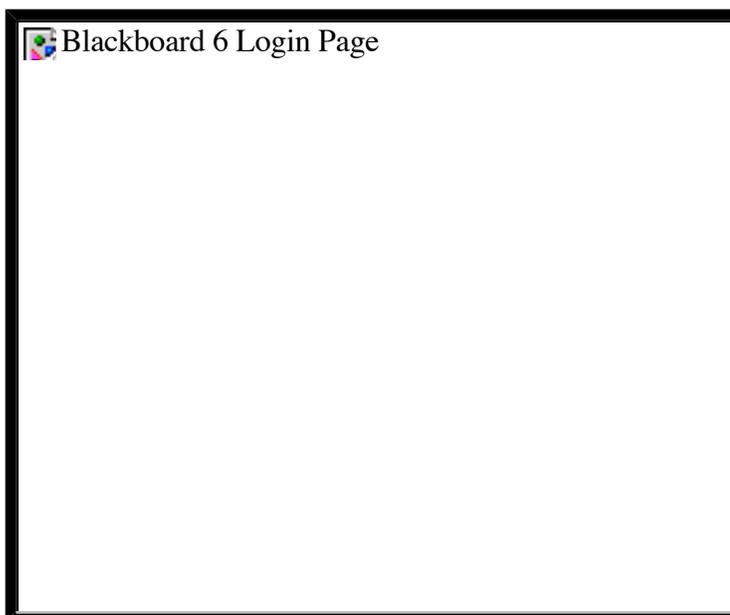
blackboard: a patient tutor in chemistry I

So let me list the most important things I think I need to do in a freshman chemistry class (Chemistry I:

chemistry majors and minors, science majors, etc.). I need to systematically present information that augments and is centered in the (US$110+) text; I need to keep students involved day to day in the course; I need to help prepare them for the three tests and for the final. This could traditionally be done with lectures, study groups, pop quizzes. And I use Blackboard to achieve these same course components with only one obvious failing: voluntary, online study groups at the freshman level have been a bust in the past eight or so years that I've used CMS (see below). Freshman are so much more timid than upper division students yet they could probably benefit the most from that sort of interactive process. (I think I've seen less than 10 spontaneously posted discussion over the past, say 500 freshman students using Blackboard.) CMS software is always available for students to access assignments, course documents, online quizzes, schedules, and syllabuses. CMS **is a patient tutor**.

Course material complete with animations, sound files, and highlighted color text is available on the course (Blackboard) web site. This material I wrote myself because I'm hesitate to use the publisher-based Blackboard-integrate-able material (we use Prentice Hall's Brown and Lemay text) because if we switch text books we'll loose copyright for that ancillary material. With that said, I have been enticed to switch texts--in that very lucrative freshman course--with promises of copyright freedom for Blackboard-downloaded cartridges from various publishers. These disingenuous offers were along the lines of "we (the publisher) promise to look the other way if you download our Blackboard cartridge material to your server and then stop using our text; it's yours in perpetuity"). I've avoided this integration of publisher material in my online offerings because--as a producer of copyrighted material--I know it can't work this way once the text and associated cartridge are dropped and I frankly resent the publishers' sales people pretending this isn't so and furthermore that this isn't a BIG issue for those CMS users who are in for the long haul. OK I'll step down now.

Blackboard's Announcements Page
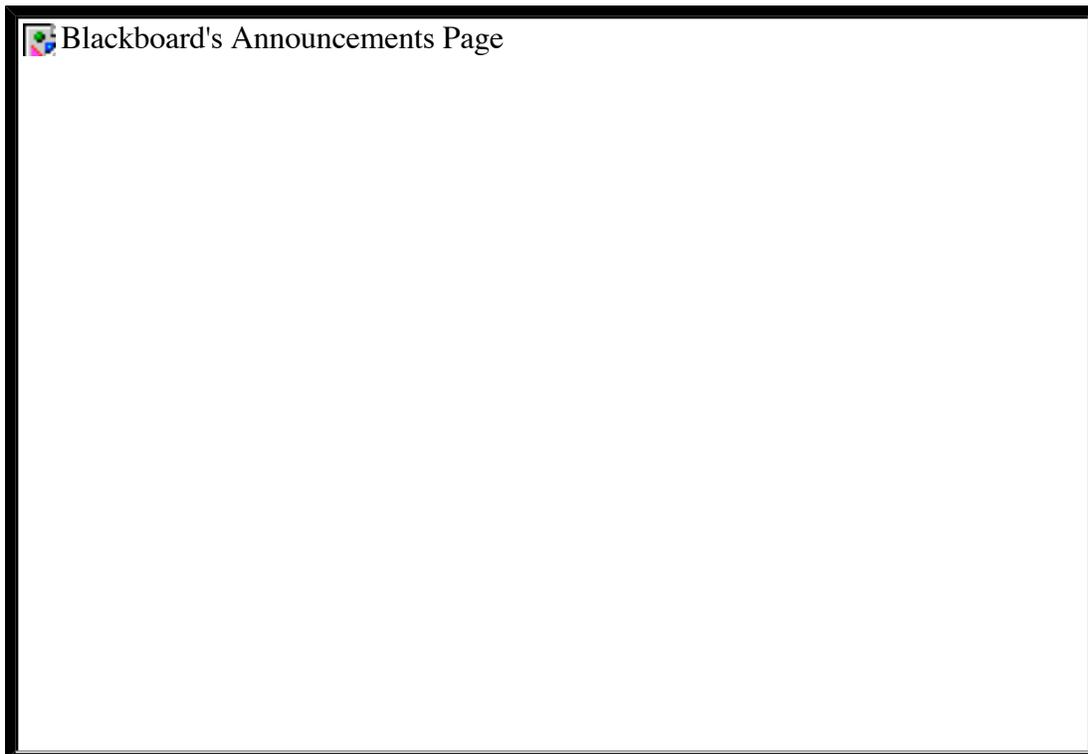
Blackboard (as with all CMS I suspect) offers lots of tools from which instructors can choose: document posting and exchange, online quizzes/testing, gradebook, internal communication formats including real-time chats and whiteboard and internal e-mail, external links, and time sensitive announcements among many others.

On its initial, announcements page--in this freshman course--I have a course outline including item by

item requirements for each test. I try my best to stick to this so students know what's upcoming but the outline has a caveat that says it might be more or less what the students are responsible for. (My upper-division classes don't have as much "upcoming" details.) Blackboard's Course Documents takes students into lesson by lesson (basically lecture by lecture) material from dimensional analysis calculations to atomic weights to the periodic table through ideal gases.

I also rely heavily on the on-line Blackboard quiz features (see below). To get credit on each quiz the student's (automatically-graded and recorded) grade must meet my predefined score threshold to get credit. For instance, if the threshold is 75% then a student's grade of 76% gets 1 point; another's grade of 65% gets a 0. So each quiz is simply pass or fail. I set a threshold and deadline for each quiz in advance. The number of quizzes I assign each semester has been increasing (15 spring 2003, 30 in spring 2004, 31 in fall 2004, 38 in spring 2005) and the quizzes *in toto* count for 15% of the course grade. The quizzes are all open book in any (unsecure) setting the student chooses, but must be submitted before a predetermined deadline. The quiz submission deadlines 2 or 3 years ago in this course were 3 or 4 days from the day they were assigned, that is assigned Wednesday but due Monday before class or assigned Monday but due Friday; however, when I checked when they were being submitted by the students--using the CMS software--most (>80%) were being submitted the night before they were due. So I realized that students were responding to long, relatively relaxed assignment deadlines with "just-in-time" quiz submissions. I think one of the reasons that my quiz assignment numbers have increase (see above) is because I'm now using quizzes as just-in-time assignments that the student must respond to before the next class, in effect forcing them to stay involved and up to date with the material as the course proceeds.

Directly quoted from my fall 2002 CCE article: "In my experience this is a relatively common manner of adopting teaching tools: we choose the tools that we see can provide a benefit. We try lots, discard lots, and keep some. I don't use overhead transparencies in my classes but find use for computer-based PowerPoint® and QuickTime® displayed via a laptop and a projector. E-mail has proven to be something almost indispensable in my teaching...a high speed streaming video server has yet to prove its worth to me in my course work (and I'm the heaviest user of computer animations and video in my department).

"I rely heavily on Server-based forums (or discussion groups) in all but my freshman and graduate courses, but so-called virtual chat rooms or white boards just don't find a place in my courses even though these are part of the Blackboard package."

The use of on-line discussion groups for my freshman Chemistry I class will be augmented this year (fall 2005) by awarding extra-credit to correct posts of the end-of chapter text problems to a homework forum; post will be checked by other students in a manner described elsewhere. I've done this in upper-division classes for many years as a function/source of a small amount of course grade. But to address the failure of "discussion group community" discussed above I'm going to institute an extra-credit version in this freshmen class also. The trick here is to increase student learning without disproportionate teaching effort (efficient assignment design).

qualifying exams and daily quizzes as a teaching tool for freshman

In addition to almost daily assigned on-line Blackboard quizzes (about 10 questions in each quiz) I assign a longer qualifying exam three or four days before each in-class test.

From CCE 2002: "At this point I'm not requiring a specific score on the qualifying exam to take the in-class lecture exam but instead merely require a recorded score before the in-class test can be taken. (This on-line qualifying exam must be taken before the in-class test can be taken.) And no, I have not [as of 2002] statistically evaluated the relationship between scores on these quizzes and qualifying exams and the associated tests or course grades (correlated? anti correlated?). I'm still experimenting with this teaching tool. The purpose in my eyes is to help students--who are often poor judges of how

they can do on an in-class exam--get feedback of their progress before it 'counts against them.'"

In 2005: A comparison of General Chemistry I students grades on (3) qualifying exams versus quiz grades was generated for spring 2005. The R^2 value is weak 0.43 (n = 44).

Note that students are *allowed* to merely click though any answer on the qualifying exam to be allowed to take the subsequent in-class test (I'm hard-pressed to stop them from taking the in-class tests with a qualifying exam score threshold; I just want them to estimate *for themselves* how prepared they are for the looming paper test; so all they're required to do at a minimum is submit the qualifying exam). But I prompt/program them 1) to carefully prepare for each qualifying exam (we discuss as a group when the best submission deadline is, given the class progress and in-class test date) and 2) take that on-line qualifying exam closed book (although there's no control of this; they take it in their own space). The clear purpose of the qualifying exam is to measure how well they'll do on the in-class test ~2 days later. If it doesn't go well then there's time to budget some additional study time before the test. When, on occasion, I've tried to drop the final qualifying exam before the final in-class exam, students have asked for it to be reinstated.

Possible more cogent from my spring 2005 data: total percentage on 38 assigned quizzes versus final exam percentage (n=40). And there does seem to be a slightly better correlation ($R^2 = 0.61$) between the final exam versus total quizzes that semester (but see discussion below). Here's how completed quizzes (*accumulated up to that test*) versus each subsequent test looked, test by test. The fall 2005, spring 2006, and fall 2006 data are included also. They were added after the fall 2005 CCE conference ended:

Relationship between individual grades (x) and assigned quizzes in a freshman chemistry class

| x	spring 2005 R^2 (x vs. Quizzes)	fall 2005 R^2 (x vs. Quizzes)	spring 2006 R^2 (x vs. Quizzes)	fall 2006 R^2 (x vs. Quizzes)	
Test 1	0.24	0.32	0.25	0.54	
Test 2	0.46	0.56	0.36	0.62	
Test 3	0.39	0.49	0.47	0.59	
Final Exam	0.61	0.45	0.40	0.50	
Course Grade	0.84 (n=55)	0.76 (n=62)	0.67 (n=44)	0.75 (n=43)	Course grade = four tests grades 85% + quiz grades 15%
Total Assigned Quizzes	38	35	40	40	

Except for Test 3, as the semester continues the correlation increased with each test. (And this was true for three of the four semesters examined; however, R^2 almost always goes down for the final exam.) That is, students who did better on assigned quizzes did better on in-class tests. This is apparent real

information that (almost) daily quizzes were helping my students. Of course the fact that weaker, less successful students were falling out means that the correlation would also go up.

Also one wouldn't want this correlation to be too good: as students learn to study by working problems then taking on-line quizzes, then qualifying exams, then in-class tests, their success should increase and if that's so then the correlation should improve but would naturally be pulled down from earlier in the semester. R^2 for total semester quiz points versus final course grade in spring 2005 was 0.84. [In fall 2004 (n = 55, other data not shown) this R^2 was 0.81 for course grade versus total quiz grade.]

Note that the course grade versus total quiz grade correlations are the highest group overall: 0.81 fall 2004, 0.84 in spring 2005, 0.76 in fall 2005, 0.67 in spring 2006, and 0.75 in fall 2006. This is a statistical "feed back" loop: Students who do well on just-in-time quizzes do better on the tests and do better on the final and so do better in the course. Therefore doing better leads to a closer correlation between course grade and quizzes. Conversely worse results on quizzes correlates and contributes to a lower course grade. But in reality the value of these course grade correlations is lessened because the final course grade incorporates a 15% contribution from the total quiz points (course grade 85% texts + 15% quizzes). This is a statement of the feed back itself. Confusing ain't it?

All in all I am quite happy with the CMS I use and am adding one new twist each semester as I learn what works for me and what doesn't.
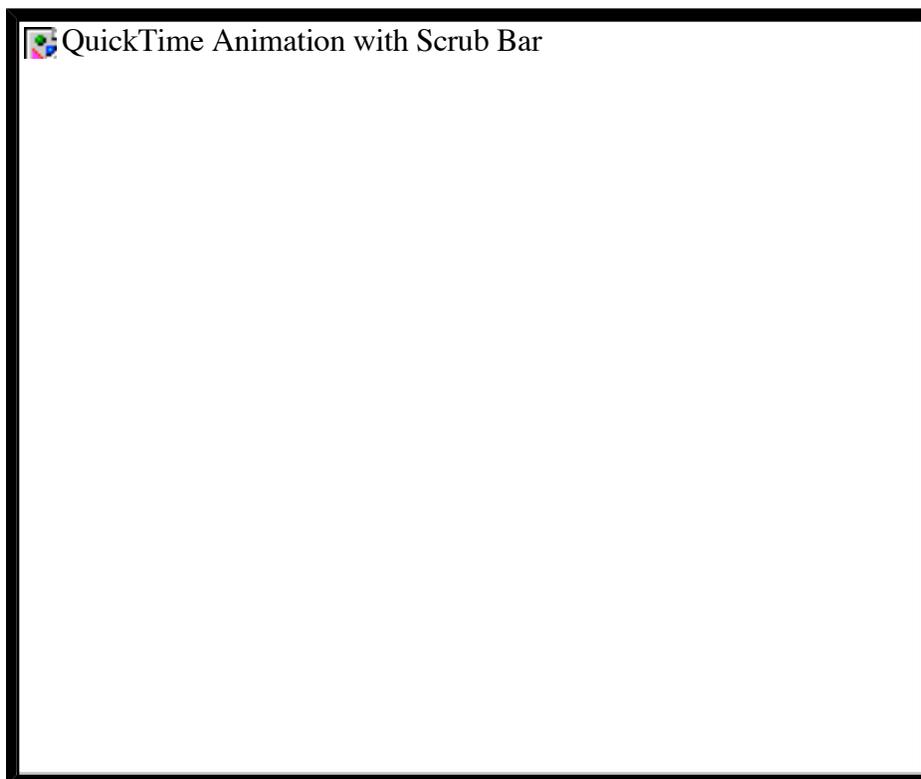
how my flash animations are changing over time

QuickTime Animation with Scrub Bar

I started using Macromedia Flash animations to teach complex instrumentation functions in my senior level instrumental analysis course. I described this in some detail in my fall CCE 2001 article but I've modified the way I construct teaching animations in the past 3 or 4 years. I initially went to Flash (.swf) format to shrink the size of the animation files from the format that I started with, bit-mapped QuickTime-based movies. The vector-based nature of Flash achieves that size reduction for the drawn schematics/animations I use, and in addition, they are user resizable to any monitor screen size with no resolution loss. An added benefit is that they can be ported as a QuickTime file with a scrubber bar at the bottom that allows instant access to any part of the file. I save each animation as a Flash, a QuickTime and even a GIF animation file, although the last format negates the internal button functions (see below). The files are available on our university's server and are available to anyone with an internet connection.

Over time I decided to try to modify the way my students interact with my animations. Even though they contained text, images (and some have sound/voice-over narration), and navigation buttons, these early animations could still be passively viewed from beginning to end. I initially approached these limitations be programming stop and resume buttons ever-present on the screen as the animation played, and then purposely programmed the delay time for pages with complex images or text to be so short that students would be required to take action to stop the animation and then resume when they were ready. In this way "getting" all the parts would require active, well, interaction on the part of the student.

Examples are:

- [Flame Ionization Detector](#) (no internal buttons)
- [Gas Chromatography with Split/Splitless Injection](#) (Stop and Resume buttons)
- [X-ray Absorption Spectroscopy](#) (Stop and Resume Buttons)

This modification changed in the past two years to files with programmed button that require the user to click specific parts (scenes) of the animation or labeled button to access different parts of the animation.

Examples are:

- [Double Beam UV/vis Spectrophotometer](#)
- [Solvent Focussing in Gas Chromatography](#)
- [Selected Ion Monitoring](#)
- [Capillary Electrophoresis Methods](#)

In these last four examples (after a few initial frames) there are parts of the animations that are never seen if the user doesn't actively click a labeled object, or button, or drag the scrubber bar if she's using the QuickTime file version.

I haven't learned yet how to program a scrubber bar inside Flash so if the user loads the Flash file instead of the the QuickTime version, navigation to the "deeper" scenes in the animation are only available via button or object clicking. Initial scenes have frames that play through by themselves and then that initial scene either repeat or stops unless the user interacts to move elsewhere in the animation. Interaction is required if the user wants the whole story.

These animations are used to teach topics from chromatography, to spectroscopy, to atmospheric chemistry. They're a welcome relief from the static images of

scrub bar
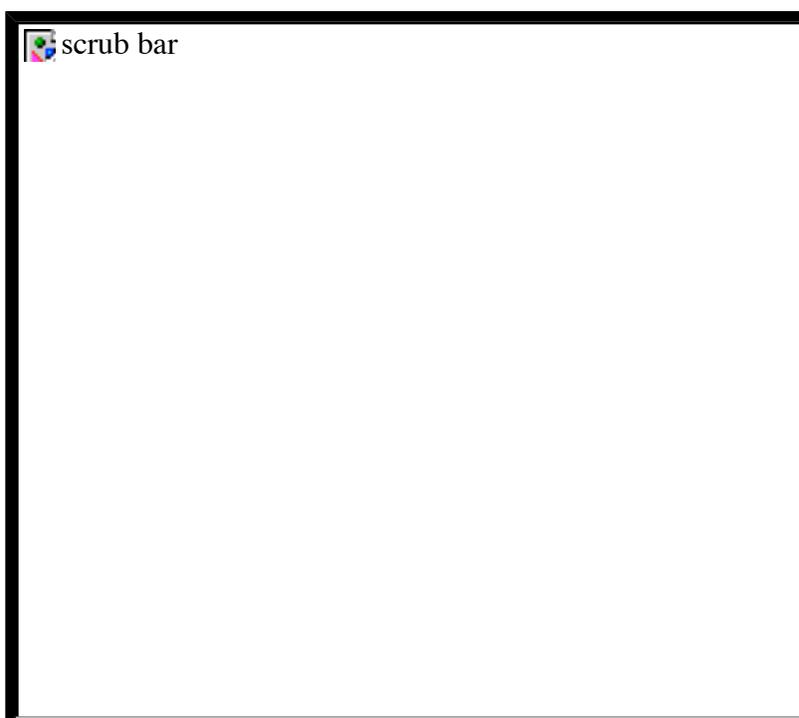
our textbooks and frankly they are fun for my students and maybe more cogent for me as I age (I'm 48 y this year) they are a very interesting hands-on tool for an analytical chemist, computer enthusiast, and life-long teacher.

On-line Bibliography

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www.blackboard.com commercial site