

First Experiences Teaching General, Organic, Biological (GOB) Chemistry Lecture

On-line.

James F. Kirby

Quinnipiac University, Hamden, CT, USA 06518 james.kirby@quinnipiac.edu

Introduction

In the fall of 2005, an opportunity presented itself: **QU Online**, Quinnipiac University's organization for on-line education, had an outside volunteer who was interested in preparing a course for our CH 101-102 sequence: the General, Organic, Biological Chemistry sequence, historically referred to as "Nursing Chem" at US institutions. Since I had the idea of preparing a course of this nature in the back of my mind, and it was suddenly thrust into the forefront. In this paper, I will discuss how *my* plans for organization merged with *QU Online's* plans for course organization, giving you a sense of:

1. what I mean by a media rich on-line course;
2. differences instructing on-line versus in a classroom (on-site);
3. differences in quantitative and qualitative instruction.

Along the way, I will discuss some troubles faced in my first attempt, and ways that I plan to change my course for my second attempt.

Organizational Planning

Our department already offered General Chemistry, through the work of Dr. Carol Fenn and Dr. Susan Henderson. I decided NOT to view their course. Many would argue that this was mistake number one for a novice. However, the audience for these courses is so different that I felt it would be best to start fresh without preconceived notions. I did occasionally consult with Dr. Harry Pylypiw in the Department of Chemistry & Physical Sciences at Quinnipiac, since he had prepared an on-line General Science course for non-science majors. Also, QU Online provided technical staff to help load and format any material that I asked them to. (This is one point that I will emphasize: *if your institution offers assistance of this nature, take all of it you can get!*)

Having spoken with Cynthia Gallatin, Director of QU Online, I was assured that the textbook being used in the on-site course in the Fall of 2005 (Karen C. Timberlake, General, Organic, & Biological Chemistry: Structures of Life, Platinum Edition, Pearson Education, Inc. Benjamin Cummings, San Francisco, CA, 2004) was from a publisher which has good content available for on-line instruction. It is imperative that you start where you are familiar. My familiarity was with textbooks. I chose to keep the textbook which was being used in our on-site course to prepare the on-line course. Using the textbook for my on-line course availed me of all materials that I had prepared for classroom lectures (especially PowerPoint lectures, which included many examples worked out for the students). It also meant that I would not have to rearrange my course organization from the previous two years in class that we had used the same textbook.

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It is important for me to add that we have been using *Blackboard* as our course management system. Loading course materials available from the publisher for this system was done by QU Online staff. Joshua Kim of QU Online was assigned to meet with me and organize all aspects of my course. I entered most of the materials that I authored (mostly lectures, using Macromedia Breeze to add verbal descriptions to my classroom PowerPoint lectures) and organized the weekly lessons by chapters using the publisher materials loaded by Joshua and his staff. They also set up chapter quizzes using a test bank from the publisher with my directions on what to incorporate. I was able to adapt them and select types of questions easily in Blackboard.

One major change to my courses came in the syllabi. *The syllabus for a course should reflect your views of success in your course.* I still wasn't sure what was needed to succeed in an on-line course! That made it difficult to prepare a syllabus. I did consult my colleague, Dr. Carol Fenn, for advice on this. This is one of those instances where, with

permission, you feel comfortable adapting someone else's work to yours. She was willing to offer her syllabus as a basis. I tinkered with it, but basically used that format. Although course and university policies are prevalent in any syllabus, it is especially important to include any policy that you plan to enforce in the syllabus for an on-line course. It is also important to inform students up front about their time commitments. I needed to point out to my students that they should expect a minimum time spent on this course to be 25 hours per week. I determined that figure by looking at the usual course being 14 weeks, with three hours in class per week. I assumed that a student had to study a minimum of two hours outside of class for every one hour inside of class. That gave 126 hours. When I split it into five weeks, it was roughly 25 hours per week. (I did tell them that 25 hours was a bare minimum to pass the course.) Also, many students think they are signing up for a course that will run at their pace. It is important to tell them immediately that this is NOT a self-paced course. I had both extremes in my classes: I had a few students who only wanted to work on the course from Friday to Monday AFTER everyone else. I also had one student in CH 102 who was looking at

Chapter 16 in the first week, having completed Chapters 11 – 15, while most of the class was working on Chapter 11! It was interesting to me as an educator that QU Online organizes all of its modules around Course Objectives. A list of objectives is seen first by a student when they look at the weekly module. That is another organization that I find interesting. The courses are NOT arranged by chapters, but by weeks. Since our summer schedule is based on two five-week sessions, I had to organize my CH 101 and CH 102, which historically covered 10 and 12 chapters, respectively, around weeks. I couldn't overlap weeks with topics, unless I changed my planned organization, since the quizzes and lecture notes were based on chapters. I actually still kept a chapter focus, but varied the number of chapters per week as necessary.

Due to prior integrity issues, our department prefers that final exams be on-site final exams. The final exam was also planned to take place during the summer school final exam slots, which were on Thursday of the fifth week of class. That shortens the last week of the on-line course, since students can work on weekends to complete other weeks, but the exam concludes the course on a Thursday.

So, how were my courses organized? CH 101 still covered the first 10 chapters in the textbook: Measurements; Atoms and Elements; Nuclear Radiation; Compounds and Their Bonds; Energy and States of Matter; Chemical Reactions; Chemical Quantities; Gases; Solutions; and Acids and Bases. CH 102 still covered the next 12 chapters in the textbook: Introduction to Organic Chemistry; Alkanes; Unsaturated Hydrocarbons; Alcohols, Phenols, Ethers, and Thiols; Aldehydes, Ketones, and Chiral Molecules; Carbohydrates; Carboxylic Acids and Esters; Lipids; Amines and Amides; Amino Acids and Proteins; Enzymes and Vitamins; and Nucleic Acids and Protein Synthesis. This was the same as for the courses offered during the academic year

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In CH 101, I organized each week around two chapters. I had one exception: Week 2 covered three chapters, since the final exam had to be the focus of the last half of Week 5. Each module was organized chapter by chapter. Each chapter started with its objectives, rather than listing all objectives for the module up front. It was followed by my PowerPoint lecture, Tutorials on chapter topics provided by the publisher, some short examples prepared by the textbook publisher called "Learning Objects," applicable Video Clips (if any), the Discussion Board for any questions, a Homework assignment due by the end of the week, a "Competency Quiz," and a Graded Quiz.

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In CH 102, students completed three chapters most weeks. Since the chapter on the lipids is much longer than most other chapters, it was covered in a week where only two chapters were completed. The final exam was still the last week of classes, so Week 5 included only Chapter 22 (Nucleic Acids and Protein Synthesis) and the final exam. Most of the weekly module organization was similar to that of the CH 101 course; however, numerical problem solving is minimized in the "Organic/Biochem" part of a GOB course. The chapters began with the chapter objectives, followed by the Breeze/PowerPoint lecture, Tutorials, "Learning Objects," applicable Video Clips (which were more prevalent in biochemistry), Group Discussion Boards (including a homework assignment completed in small groups), Class Discussion Boards, a "Competency Quiz," and a Graded Quiz.

Note: To view examples of some weekly modules from CH 101 and CH 102 (without active Discussion Boards), please check out <http://blackboard.quinnipiac.edu>. To enter, simply use USERNAME **quonlineguest** and PASSWORD **guest**. Chapter 2 in the Week 1 Module of CH 101 shows good examples of tutorials, video clips, and learning objects. Many examples of the tutorials are shown in the Chapter 20 module. The disadvantage of the demonstration modules are that they are missing the Discussion Boards, which are the main homework and group work in the CH 102 course.

PowerPoint Lectures Using Macromedia Breeze Publisher

As I stated earlier, the lectures included my voice in a PowerPoint slide format. They were "published" using the Macromedia Breeze Publisher. (Slides like the figure below are accompanied by my lecture. I can emphasize what is on the slide or speak about other related information.) Students are instructed in a "pre-class week" run by QU Online to install and use all of the necessary hardware for the course. Their ability to use Breeze is included in this on-line instruction. (They also have access to the first week of the course to try out their technology and get an early start, if they want to do so.)

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Tutorials, Learning Objects and Videoclips

These materials were provided by the textbook publisher and loaded by QU Online staff. I selected the materials from a menu which was only open to me as the Instructor. I placed the materials that I thought best fit my course in the selected chapters. An example of a "Learning Object" was an empirical formula problem worked out step-by-step to

show all calculations. This may be found in the weekly module for Chapter 6 and 7 of the CH 101 course under Chapter 6.

An example of a video clip was Le Châtelier's Principle using $\text{Co}^{2+} / \text{CoCl}_4^{2-}$. The video clips are important for this course because some students are NOT taking a lab concurrently. This is their visual demonstration of chemistry! This video clip may be seen in the weekly module for Chapters 6 and 7 of the CH 101 course under Chapter 7. The screen shot below was taken from a video clip in Chapter 2 entitled "The Physical Properties of the Halogens."

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The tutorials covered topics like protein structure (in the CH 102 week 4 module, under Chapter 20 -- multiple tutorials on the various types of protein structure) and the metric system (in the CH 101 week 1 module, under Chapter 1). They were not specifically attached to chapters. The polymers tutorial applied to four chapters in the course. When I used it, I emphasized which portion of the tutorial was of interest in that chapter, as can be seen in the CH 102 course, under week 1, Chapter 13 and also under week 4, Chapter 20.

Discussion Boards and Homework

In both courses, I opened discussion boards where students were expected to ask questions and answer other students' questions. This was part of their "class participation" grade for the course. Of course, I would add comments when appropriate or when a question stumped all students who checked the Discussion Board.

In CH 102, I also used Group Discussion Boards. For my on-site courses, I have given a set of essay questions at the first class as a source of final exam questions. I used those questions on a chapter by chapter basis for my Discussion Groups. I asked each student to provide an answer to the members of the group, to compare and edit answers to come to a group answer, and then to post the group question and answer to a separate part of the Class Discussion Board. Students were also asked to look over these answers and ask questions or comment on any answers from other groups. The Group Discussion Board work constituted the "homework" part of CH 102. In CH 101, I assigned one or two problems from the end of each chapter that had to be turned in using the Assignments feature in Blackboard. It allows a student to submit an assignment either by typing it in or attaching a Microsoft Word document. It then allows me to grade the assignment and post a grade directly to the course Gradebook in the system (Blackboard).

Competency Quizzes, Graded Quizzes, and Final Exams

"Competency" quizzes were "practice" quizzes that gave students the opportunity to try a sample quiz any number of times. Quizzes were randomized. With the number of questions in the test bank, it was unlikely that they would see all of the possible questions on a sample quiz. Students were required to earn at least 80% on their Competency Quiz. If they did, they would earn all points for their class participation grade.

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The "Graded Quiz" was similar in format and could have contained some questions seen in the "Competency" Quiz. The Graded Quiz would count in their overall course average as the grade earned. This quiz could only be taken once. The final exam was administered on-site or at pre-approved proctoring sites. It was NOT on-line. Students were required to bring proper identification to the final exam. Also, the syllabus was written such that the students were required to pass the final exam to pass the course, although that policy was not enforced. This was listed as a measure to protect against cheating, where a student might receive "A" grades on all materials up to the final exam and not being able to score a passing grade on the final exam. Another method to prevent against cheating was inclusion of a notebook showing all work completed during the progress of the course, which needed to be submitted at the final exam. Students who arranged proctored exams were required to send their notebooks directly to the instructor by mail or courier service.

Differences in Instructing On-line versus On-site (in a Classroom)

I'm not sure I could fully describe what I perceive to be the differences in instruction. I think Carol Fenn described it best when she called herself a "coach," guiding the students through the course. I see the instructor as an organizer, source of information, one who answers any questions (ultimately), and a "judge" of the talent on the other end of the network connection. The choice of materials to post in an on-line course shows what you feel is most important to teach and for the students to learn in your course.

This causes many students to ask if they are responsible for "teaching themselves." On the surface, it seems that this complaint is true. However, if you guide them well with your choice of materials to present, have a good main source (textbook) and, most important of all, you check your course or e-mail (your preference) for questions and comments that need your response frequently, you are doing the best on-line teaching you can.

The most difficult part for me about teaching on-line was not making direct personal contact with my students. Although I don't see a vast majority of the first-year students that I teach again in their academic careers, I like being able to make even a temporary bond with my students. It is much harder when you don't even see them, when your interaction only consists of those students being on the other end of a network connection. How to make a stronger bond and know your students better is a question I can't answer. I did use an "Introduce Yourself" assignment as the first Discussion Board assignment, but how much will a student share and how much will you learn from that one assignment? On top of that, there is little that can be done in a five week course when students can be working on your course literally any time of the day or night.

Teaching Quantitative Material versus Qualitative Material

Of all of the challenges to offering a good course in chemistry, this is the greatest. Many people with whom I have spoken who have taken or taught courses with quantitative reasoning have commented that the students feel that they have to teach themselves or find someone with whom they can speak directly whenever they have trouble understanding quantitative concepts or applications. Qualitative material seems easier to digest through examples and discussion boards.

Some of the "Learning Objects" were demonstrations of problem solving, applying the new material and attempting to show how to apply the new concepts quantitatively. I don't think most students found this to be sufficient. One colleague in Mathematics has suggested using the Group Discussion Board and making the assigned groups solve all homework problems and submit a group answer. This may be the way I attempt to correct the issue of student difficulty in problem solving. The only difficulty I see is with participation. I noticed in the CH 102 sequence that many students would let the best student in the group answer first. They would then write a similar answer to the

question to come to a consensus.

One of the comments that I have heard and made for years is "The best way to learn how to solve problems is to solve problems: practice, practice, practice." In assigning only a couple of specific problems, I limited the scope of the students' focus. I don't think the average or below average students were convinced that they still needed to solve other

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problems. This is where assigning more problems would help. However, it comes back to grading more problems. That is what makes group problem solving an appealing idea. If four people are in a group, you only need to grade one-fourth of the amount of problems. If it is a weekly assignment for a class of twenty, for example, then you grade 5 sets of problems instead of 20. You can assign more problems and still not get bogged down in grading.

Many publishers have available programs specifically for assigning and grading homework. Not having tried any particular homework management system, I can't comment on them. However, that is another option that must be considered, especially if the system guides students through problems that they did not solve correctly.

Concluding Thoughts

It is often said that we don't want to reinvent the wheel. Many may think that we are reinventing the wheel when we prepare a course for on-line instruction. Others simply see it as another method for presenting what you know best and want to impart to your students. The incorporation of video clips and other methods of studying or problem solving which use media make it more interesting to students. The ultimate question in preparing your course is "Does the course and its contents help your students learn?" If, at the end of the course, the answer to the question is that your on-line course is as effective as your on-site course, you have prepared a great class. If it is more effective, make sure you incorporate the techniques and assignments from your on-line course in your on-site course. If it is not as effective, decide what needs improvement. I will continue to teach the General, Organic, and Biological Chemistry course on-

line during the summer. I will also continue to discuss with colleagues and the people from QU Online what I can do to improve my course. Of course, I hope that this paper leads to much discussion about how to prepare stellar on-line offerings that make chemistry more interesting to all students.

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