

Final report
Interactive Electronic Textbook for Physical Chemistry

The goal of this project was to develop an online, interactive evaluator-integrated electronic textbook (an EIB) for use in upper division physical chemistry courses. The target audience of the EIB is biology and biochemistry students for whom physical chemistry is a required course. The material covers basic physical chemistry, with emphasis on biochemical examples and techniques. The unique aspect of this EIB is addition of Flash-based interactive figures, interactive examples and interactive homework problems, all produced and delivered via the UMass Amherst OWL (Online Web-based Learning) system. These goals are those originally proposed.

A near complete text was written and delivered to the 78 students in CHEM/BIOCHEM 471, Elementary Physical Chemistry, in the Fall 2007 semester. The text includes 11 chapters, each broken into 3 to 16 sections. Embedded within the text are 43 interactive OWL-based example problems. Another 15-20 of these examples remain to be written. Also included in the interactive question database are about 200 homework problems, most of which were written under a Professional Development grant last year.

This text was used as the basis for my course (CHEM/BIOCHEM 471) in the Fall 2007 semester. The class as a whole successfully completed 28.7 of the 43 embedded problems. (Two students completed none, one completed 1, one completed 2 and one completed 3. Eighteen students completed all of the problems.) All students looked at all chapters of the book. Some students printed some or all of the book, though I don't know how many did this.

Students were queried on the usefulness of the OWL EIB at the end of the semester. The queries were done in consort with the standard SRTI evaluation of the instructor and course. In response to the question "Comparing the eBook to an identical hardcopy book, which is better?", students responded with a mean of 3.23 (5 being eBook far superior, 1 being hardcopy far superior). 29% of respondents answered "5". Student comments about the eBook include

"A hardcopy of the ebook would have greatly helped. I find it very difficult to read lengthy text online, when it takes me less time off the computer."

"I liked the eBook and the problems inside it. Most often students skip past the text book problems in a chapter. This made it necessary to do them."

"The e-book has a lot of typos that should be corrected. Also, it would be helpful to have more example problems to work out."

"... textbook made material very accessible."

"eBook was helpful."

"I really like the lecture slides and the ebook. They are very useful when/during reviewing."

Lisa Lockwood of Cengage Learning (formerly Thomson) had Prof. Philip Rea of the University of Pennsylvania Department of Biology review the text at its halfway point. He said “I really like the beginnings of David Gross’ OWL PChem for Biologists eBook. The science and writing are first rate. What I'd do to get students and other instructors hooked is put a top notch web graphics person on the project with whom Dave might work to incorporate images of the devices used to make the measurements described and sharp diagrammatic renditions of the problems and their solutions. The power of ‘image’ is not to be underestimated...science is as much an aesthetic experience as an intellectual experience (not that the two are necessarily not one and the same thing).”

Lisa has since engaged other reviewers who are anonymous from Prof. Gross. These reviewers saw the EIB after its use in CHEM/BIOCHEM 471 but before it included the Flash figures that are the subject of this grant. Some comments from these reviewers are

Q: Do you think that students in your course would be more or less likely to do readings and homework using an interactive online text as compared to a hardcopy text?

A1: My opinion is that this may encourage them to do more reading. My experience is that most students (even graduate students!) find a PChem textbook pretty dry and so don't read the text very thoroughly. Perhaps an interactive online text might help them to read and think while reading.

A2: The idea of an OWL based course is very exiting, while the ebook is less exciting. However, if we were to use an ebook in any of our courses, this would be one of the few in which it could succeed.

Q: Please comment on both the quantity and quality of these example problems. How could they be improved? Are the hints a useful addition to the problems? Is the feedback provided by the problems adequate? Do you think that your students will find these example calculations useful? Should there be more of them in the text? Would you assign them for a grade?

A1: I liked both the quantity and quality of the examples with the strong connection to biological systems and problems. I clicked on several of the hints and found them to be useful. The feedback is good and will help the student to identify what they do not understand. I think the number of examples is adequate. If there are too many examples the students is not likely to work through many if any and become discouraged. I would rather see the student to carefully work through a few examples than skim through many without any real comprehension. I personally would not assign the examples for a grade.

A2: The Biochemical examples are extremely good for this course. I would like to see clearer comparisons of biochemical processes and inorganic reactions, but this is a strong point of this text, and I would only expand these to include the comparisons.

Q: Please comment on both the quantity and quality of the artwork. Are enough illustrations used? Would you think that the book would be

improved by figures with which students can interact to change numerical values, push pistons, spin molecules, and so forth? Would you like to see interactive examples in which students must supply a correct answer to proceed to the next level of difficulty?

A1: Artwork is important in an online book. I do feel it is important for the student to interact with the concepts and this is possible with a good graphical interface. Interactive examples requiring correct answer for progress could be important and useful.

A2: The artwork in the text is adequate, it compares to that used in other texts. However, this being an ebook, I would expect to see some more impressive artwork in the future, as well as some animation and interaction. I personally don't think you can ever have enough illustrations and teaching aids, so yes I would like to see more illustrations and interactions.

A major piece left to do on the EIB is to create the Shockwave Flash interactive figures. To date only one has been produced and embedded into the EIB. As the reviewers note, this will be a key addition for the book. The Flash content has been slow in production due to lack of time by the programmers. I have made arrangements with a local company, Cowtown Productions, to produce the Flash figures. The modules produced by Cowtown have the professional look that Philip Rea suggested, and are produced by a group that has much experience with the OWL interface. Cowtown is presently finishing a large contract and will have time for my figures in July, 2008. The interaction between me and Cowtown will be mediated by Prof. William Vining of SUNY Oneonta, a former UMass Chemistry professor and the founder of Cowtown. My figure storyboards will be reviewed by him and he will submit them to Cowtown programmers. This arrangement should get the 50 or so Flash figures completed by the start of the 2008-2009 academic year. They will be used in CHEM/BIOCHEM 471 in the Fall 2008 semester. A standing purchase order for the Flash modules has been established with Cowtown. Modules will be produced until the account funds are completely exhausted.

Also remaining to complete are five sections of three different chapters in the book, some suggested by reviewers and some that were not completed in time for the first use of the book. These sections and their complementary OWL-based homework problems will be written and incorporated into the EIB.

The PI will use a small amount of the grant funds for the purchase of Adobe Flash authoring software. This he will use to produce more Flash figure modules as he teaches himself Flash programming. The professional Cowtown modules will be used as learning tools. Subsequent additions to the EIB will cost nothing.