

Final report  
Interactive Online Homework for Chemistry 471  
David Gross, PI

The goal of this project was to develop a complete set of interactive, parameterized homework problems based in the Online Web-based Learning (OWL) system for Chemistry/Biochemistry 471, Elementary Physical Chemistry with an emphasis on biochemical examples. (CHEM 471 became crosslisted with the new BIOCHEM 471 course approved in the summer of 2006.)

Although the proposal listed David Gross and Robert Weis as co-investigators on the project, ultimately Prof. Weis did not have the time to spend to work on the project. Prof. Gross worked through the summer of 2006 and during the Fall 2006 semester to write, debug and organize the OWL homework content for CHEM/BIOCHEM 471. He was the instructor for the course in the Fall 2006 semester.

Approximately 250 separate homework problems were produced and incorporated into 57 separate instructional unit modules. About 90% of the problems were parameterized such that the question appeared with different values or content upon each initiation of the question. The different values appeared randomly, as did the selection of questions each student received. The homework assignments were delivered to the 75 students taking CHEM/BIOCHEM 471 in the Fall 2006 semester. Additionally, a set of seven online exams was produced and delivered to the students. The homework problems and timed exams were assigned to all students; the assigned OWL homework counted 30% toward the final course grade and the OWL exams counted 20%. The use of graded homework prompted most students to do most of the work. Of the 52 graded OWL modules that were assigned, students on average completed 48.9. Of the 75 students, 44 successfully completed all 52 of the modules, and 59 of the students completed 50 or more of the modules. Of the 75 students, 58 completed all seven of the online exams assigned. Most of the remaining 17 students failed to take one or two of the seven online exams.

Of the students who completed 50 or more of the online homework modules that were assigned, the lowest course grade was a C+. Of the students who completed fewer than 50 of the homework problems, the course grades were mostly Cs and Fs, with two Bs and one A. Because only 30% of the course grade was based on completion of the online homework, the strong correlation between homework completion and final course grade suggests that the OWL homework improved students' performance on exams. More data from future offerings of CHEM/BIOCHEM 471 will permit further clarification of this assertion.

Students were queried on the usefulness of the OWL homework at the end of the semester. The queries were done in consort with the standard Student Response to Instruction (SRTI) evaluation of the instructor and course. In this evaluation undertaken by the class at the end of the semester, students felt strongly positive toward the statement "The OWL homework was helpful in learning the course material." (on a scale from 5-very helpful to 1-not at all helpful the student response was 4.70).

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Some examples from the OWL materials produced during this grant were presented by Prof. Gross at the University of Massachusetts Information Technology Council Instructional Technology Conference at Sturbridge, MA in April, 2007.

With this framework base of material, future instructors in CHEM/BIOCHEM 471 can readily adapt and expand the OWL homework content. Prof. Gross will be instructing the course during the Fall 2007 semester, and he has begun work toward an enhanced use of the OWL homework content for the course. He plans to deploy an electronic textbook (eBook) on OWL for CHEM/BIOCHEM 471 in the Fall 2007 semester, and has received an award from the Information Technology Council's Subcommittee on Academic Technology for this purpose. In addition, Prof. Robert Moll of the Computer Science Department on this campus and David Hart, Director of the Center for Educational Software Development on this campus are co-investigators of an infrastructure grant from the same source to support eBook development. The eBook for CHEM/BIOCHEM 471 under development will replace the current less-than-satisfactory hardcopy textbook. The eBook is envisioned to include full text, linked OWL problems as examples, linked OWL homework assignments and active figures for student exploration of course content. Prof. Gross has discussed the marketing of this physical chemistry eBook with Thomson Learning (the current purveyor of other UMass Amherst-developed OWL content). Lisa Lockwood from Thomson has indicated an interest in the content, and wishes to deploy a sample chapter from the eBook as soon as it is available.

Because Prof. Weis did not take part in the present project, a portion of the grant budget reserved for his summer salary was put toward the purchase of a tablet PC. This purchase has allowed a secondary goal for the project, which will be implemented in the Fall 2007 semester. The tablet PC will be employed for course instruction to allow simultaneous text/problem/"eboard" display to students in class, with in-class content being archived on the course web site for student review after class. The present lecture component of the course involves hand chalking of a blackboard with derivations and diagrams of the course content. The tablet PC will permit these activities to be projected so that students can more easily see them and will permit archiving of these materials as noted above.

Expenses budgeted to the grant were in line with the awarded \$5000:

D Gross summer salary (1.2 weeks):	\$2049
Dell desktop computer:	\$1137
Software for above:	\$ 387
Gateway tablet PC (refub):	\$ 849
Software for above:	\$ 284
Extended warranty for above:	\$ 250
Misc:	\$ 73

(Note: The total adds to \$5029. Other funds were used to cover the \$29 excess costs.)