

**University of Massachusetts  
Academic Year 2003-04  
Final Report On Professional Development Grant**

ChemPrep

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Campuses Involved: Amherst, Boston  
Disciplines Involved: Chemistry, Computer Science  
Funds Awarded: \$15,000

**Summary**

Two self-paced chemistry courses were written for the OWL (Online Web-based Learning) system. The intent of these courses is to improve student preparedness for first semester General Chemistry and first semester Organic Chemistry. Topics covered in each course are summarized in Table 1. The curriculum for each course was evaluated by students and chemistry faculty prior to use by the target audiences.

**Table 1**

**General Chemistry Curriculum  
Organic Chemistry Curriculum**

1. Introduction to the OWL System
1. Introduction to the OWL System

2. The Structure of Matter
2. The Electronic Structure of Atoms
3. Naming Chemical Compounds
3. Lewis Structures
4. Measurement and Calculations
4. Shapes of Molecules
5. Calculations involving quantities of matter
5. Electronegativity and Polarity
6. Chemical Reactions
6. Bonding, Hybridization, Resonance
7. Algebra, Temperature, Density, Graphs and Logs
7. Structures and Nomenclature
8. Course Survey
8. Bronsted Acids and Bases
9. Course Survey

All UMass/Amherst students enrolled in Chemistry 111 or Chemistry 261 for Spring 2004 were invited to participate in the pilot study conducted during January 2004. The number of students participating in the pilot is summarized in Table 2.

**Table 2**

	<b>Number of Students</b>
	<b>General Chemistry</b>
	<b>Organic Chemistry</b>
Completed > half of the work	30
	40
Completed < half of the work	40
	22
Signed up, Did not use.	21
	14
Total enrolled Spring 04 class	343
	137

A detailed evaluation study following the performance of ChemPrep participants in the subsequent Spring 04 courses was conducted. The complete text of this study is included at the end of this report. **Key Findings** from the evaluation study for both General and Organic Chemistry are:

- **Grades on the first exam were higher for those students who did more than half of the work in the preparatory class than for any other group**, with exam grades positively associated with more work in the preparatory class.
- **The number of students who were retained in the courses was higher for those completing 50% or more of the prep course.**

With these positive results we will expand the offering of the ChemPrep courses to all Fall 2004 students of General Chemistry (Chem 110, 111 and 121) and Organic Chemistry (Chem 261 and 265) on the UMass/Amherst campus. We will also invite all entering students in general and organic chemistry at UMass/Boston to participate in this program which will be conducted in August.

Modifications to the OWL system to improve delivery of self-paced preparatory courses were

performed by programmers at the Center for Computer Based Instruction (CCBIT). A little more development work will be done over the summer on tutors specific to the courses.

We have begun discussions with UMass OnLine to determine the feasibility of offering the ChemPrep courses to students throughout the Commonwealth.

#### **Final Note**

We would like to acknowledge the key role that the Professional Development Grants Program has played in providing seed money to develop and disseminate OWL for chemistry. Thomson Learning (formerly Harcourt Publishing) has licensed OWL for both General and Organic Chemistry to accompany six of their chemistry textbooks. UMass OWL was used by over 100 colleges and universities across the country this past year.

Last fall the Provost's Office liked the concept of ChemPrep enough to use it as model for a preproposal entitled *Creating a Comprehensive Course Readiness Program* sent to the Department of Education Fund for the Improvement of Postsecondary Education (FIPSE). The proposal extends the idea of providing preparatory courses delivered through the OWL system to beginning calculus, physics, statistics, biology and computer science. While the proposal was not funded, it received favorable reviews and will be resubmitted in the next cycle. In addition, UMass OnLine has indicated interest in serving any preparatory courses developed as a result of this effort.

Once again the Professional Development Grants Program has provided a springboard for improvement in undergraduate education and seed money for pursuing outside funding opportunities.

#### **Budget Expenditures**

##### Summer Development Salary

Botch	\$2,000
Day	\$2,000
Hixson	\$2,000
UMass/Boston Work	
Schwartz	\$1,000
Tutor Development	\$1,750
OWL System Development	\$3,000
Evaluation	\$3,250
Total	\$15,000

## ChemPrep Evaluation Study: Preparatory Course Users vs. Non-Users Performance in General and Organic Chemistry

### Overview

In January, 2004, preparatory courses were offered for the first time to all students registered to take General Chemistry I (Chem 111) and Organic Chemistry I (Chem 261) in the Spring 2004 semester. Students were invited via a series of emails, and respondents to the emails were registered in the courses.

Of these respondents, some completed all or most of the preparatory course, a similar number completed less than half, and several signed up but never completed any assignments. This report compares the scores of these three groups and the fourth group of students who never responded to the emails on course performance measures.

### Summary of Results

Two measures were examined in relation to the four groups above: scores on the first exam and amount of OWL homework completed by April 12th. A summary of the key findings from these measures:

- In both General Chemistry and Organic Chemistry, the grades on the first exam were higher for those students who did more than half of the work in the preparatory class than for any other group, with exam grades positively associated with more work in the preparatory class.
  - This amounted to a difference of about 10 points (out of 100) between those who did more than half of the prep course work and those who did none in General Chemistry and about 6 points in Organic Chemistry.
  - When the General Chemistry data is broken down by section, the analysis becomes a bit more murky, but because these are such small groups and the scale is the same for each section, it seems appropriate to combine the data.
- Also in both cases, the number of students who were retained in the courses was higher for those completing 50% or more of the prep course
  - In General Chemistry, approximately 15% of those who did not sign up dropped, compared to 7% of those who did. In Organic Chemistry the numbers were 5% and 4%.
  - Examining this analysis on the granularity of the three different groups within the prep set becomes murkier, with fewer consistent patterns.
- In General Chemistry, the OWL use figures varies so much between sections that the combined data are difficult to interpret.
- In Organic Chemistry, there is a pattern wherein more prep course work is associated with more work on OWL during the class.

### First Exam Results

For both classes, first exam scores were examined for each of the four groups. The scores are shown on the tables below, along with their breakdown into ranges.

#### [General Chemistry](#)

#### [Organic Chemistry](#)

The shaded regions indicate the range of scores on the exam and the percentage of students who received exam scores within those ranges. Percent dropped is calculated by the number of

students who did not take the exam but did register for the class (as measured in OWL).

There is a clear pattern in both classes whereby students who used the prep course did better than those who did not register, and students who used it more did better than those who used it less. The difference between the second and third columns in the General Chemistry table is small and probably insignificant given the small N.

### **OWL Use Results**

A second analysis was performed examining the use of OWL in class in the four groups. This was done by looking at the total students score in OWL for assignments due up to April 12th as compared to the complete number of points possible.

In performing this analysis, it quickly became apparent that, in General Chemistry at least, the three sections were very different in their OWL use. Not only did they all have a different number of OWL assignments that students were required to complete, they also had considerable differences in the proportion of points that students completed. For this reason, the general chemistry results are presented by section as well as in total. This has the disadvantage of making small N's per group, but since the proportion of each group is different across sections it is necessary to look at the data this way.

There were no comparable problems for the Organic Chemistry data.

It should be noted that the students examined in these tables are only those students who took the first exam-other students who may have done some OWL but left before the first exam are not included. Also, the ranges of scores are for the percentage of total possible OWL points that the students scored.

The patterns here are not nearly as strong as for the first exam results, and are difficult to interpret.

[General Chemistry](#)

[Organic Chemistry](#)