

### **CASE STUDY: COLLEGE OF CHARLESTON**

**Instructor:** Dr. Jason S. Overby, Associate Professor, Department of Chemistry & Biochemistry

**Academic Objective:** To recapture lecture time to focus on instruction and go deeper into course syllabus.

To enhance student understanding of general chemistry concepts through assignment of graded homework and rigorous quizzes.

#### **Academic Background and Challenge:**

The College of Charleston is a nationally recognized, public liberal arts and sciences university located in the heart of historic Charleston, South Carolina. Founded in 1770, the College is among the nation's top universities for quality education, student life and affordability.

The College is home to a faculty of 500 distinguished teacher-scholars, who serve approximately 10,000 undergraduates and 1,500 graduate students from all 50 states and from 68 countries. Students pursue studies in business, science, teaching, the humanities, languages and the arts.

Within the College, the Honors College is dedicated to providing bright, motivated students with a dynamic learning community where they can develop their intellectual potential and career interests.

The Honors College challenges intellectually talented students to make the most of the opportunities available to them and to become actively involved in their own educations. Admission to the Honors College is highly selective, and only a small percentage of applicants are accepted. As a result, Honors College courses bring together small classes of intellectually gifted and highly motivated students who work with faculty members specially selected to teach Honors students.

Dr. Jason S. Overby, Associate Professor, Department of Chemistry and Biochemistry, teaches Chemistry I and II (introductory chemistry) in the Honors College. Typically 20-25 Honors freshmen – the majority of whom are science majors – are enrolled in this two-semester, full year course.

#### **Honors College Chemistry I & II with ARIS: Pilot Program History and Goals**

The instructional format of Honors College Chemistry I and II had varied slightly over the years, but typically consisted of:

- Lecture – 3x/week for the 15-week semester
- Weekly lab
- Print textbook; online content delivered by WebCT (now Blackboard)
- Optional end of chapter homework problems, which students completed by hand; these problems were not graded or corrected (it was impossible for the instructor to grade this volume of quizzes by hand in addition to the work load from other courses)

- Weekly in-class quiz – short, 3-4 question multiple choice quiz, hand-graded by Dr. Overby
- End of semester and final exams, using the American Chemical Society's standardized exams

Several years ago Dr. Overby also added an online homework component to the course structure. His chief objective in doing this was to recapture lecture time that had been previously dedicated to weekly in-class quizzes. Assigning weekly online quizzes to students – to be taken at students' convenience, outside of the classroom – would enable Dr. Overby to spend more lecture time on instruction, and thus go deeper into the course syllabus.

In addition, the auto-grading feature of an online homework tool made it feasible for Dr. Overby to add a graded homework component to students' required coursework. Making homework a graded component of the students' required work made it much likelier that even highly-motivated students (like those in the Honors College) would actually do the work. And, as Dr. Overby noted, in a problem-solving subject like chemistry, getting students to do homework problems is an essential part of ensuring skill development and content mastery.

Unfortunately, however, Dr. Overby had become "disenchanted" with some online homework solutions, finding them "too hard to use" for students and instructor alike. These usability issues were compounded by "too many errors in content" and "content itself that wasn't particularly engaging and too narrow in range."

In the summer of 2006, convinced that the right online homework solution could meet his and his students' academic needs, Dr. Overby reviewed a variety of homework and course management systems on the market. He selected the ARIS system to pilot for the 2006-2007 Honors College Chemistry I and II course sequence, for three primary reasons:

- Ease of use – much easier for both students and instructors to use than previous systems
- Range of content – much broader range of content than other systems
- Variety of content – greater variety of content, and content also correlated to the McGraw-Hill course textbook, *Chemistry: The Molecular Nature of Matter and Change*, by Martin Silberberg

**Prof. Overby selected ARIS for its "ease of use – much easier for both students and instructors to use than previous systems."**

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Dr. Overby's objectives for the ARIS pilot program were:

- To implement an easy-to-use online homework system that would be intuitive for students to use independently outside of class time, while also providing the real-time, contextual support they needed
- To utilize rich and varied content to create and assign more robust quizzes and homework
- To make it easy and efficient for instructors to create and grade quizzes/homework assignments
- To add graded homework to students' required coursework in order to support development of chemistry problem-solving skills and to lift student learning outcomes.

### **Honors College Chemistry I & II with ARIS: Pilot Program Design**

- 2007- 2008 Honors College Chemistry I and II, a two-semester course (15 weeks per semester)
- Instructional format:
  - Three lectures per week – same as traditional course format
  - One lab per week
  - Weekly ARIS homework problems
    - One required set of 10 problems to solve per chapter – 150 total problems due over the course of a 15-week semester
    - This homework was graded – unlike previous homework – but students had all week to complete the assignment, and could work on each problem multiple times using ARIS tutorials and other contextual help to “move them along” and complete their work.
    - Dr. Overby reported that most students did their homework from 10 PM- 1 AM, when he wasn’t available to assist them, so students benefited from having ARIS tutorials and other contextual help available to them for “just in time” homework help.
- Weekly ARIS quiz
  - More problems to solve – 10-15 problems per chapter, 3x the previous number
  - Harder questions, richer assessment – students were required to solve problems, as opposed to the multiple choice questions for the previous format.
  - Students got only one try at solving problems, as this replaced the weekly in-class quiz, but they had all week to complete the quiz independently.
  - Over the course of each semester, students had to solve 225 quiz problems, versus answering 60 multiple choice questions in the previous course format.

### **Pilot Program Results:**

Upon completion of the 2007-2008 Chemistry I and II course, Dr. Overby reviewed academic performance data for his students against historical data points and independent general chemistry instructional benchmarks. His analysis led him to conclude that the ARIS system delivered a measurable lift in student learning achievement. Specifically, his data analysis revealed:

### **Quantitative Impact: Improved Student Learning Outcomes**

- **8% increase in fall 07 semester exam scores** for students over fall ‘05 scores – using exactly the same textbook and giving exactly the same exams
- “Very significant” increase, Dr. Overby noted, especially for Honors College students who are already high academic achievers

**8% increase in fall 07 semester exam scores for students, versus fall '05 scores – using exactly the same textbook and giving exactly the same exams**

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- **6% increase in spring 08 semester exam scores** for students over spring 06 final exam scores – using exactly the same textbook and giving exactly the same exams
- **6% improvement in student scores on the American Chemical Society's standardized final exam**, an independent measure of students' mastery of core general chemistry concepts
- **Boost in final grades: fewer "C" grades, "B" students lifted to "B+"**
  - Impact especially pronounced at the lower end of the grade spectrum – students at the bottom end of the Honors program – raised them up from the "C- " range to "C+" or "B-"

### **Qualitative Impact**

End of semester student feedback surveys found a majority of students commenting "we're glad you made us do this" when queried about ARIS online homework and quizzes.

- Dr. Overby observed a dramatic reduction in the number of student "how to" questions about using ARIS, how to input data, and so forth, indicating students found the ARIS interface and system generally much easier to use than other online homework systems.

### **Future ARIS Plans**

Dr. Overby used ARIS again in Honors College Chemistry I in the fall semester of the 2008-2009 academic year.

- Fall 08 Chemistry I – ARIS delivered a 7% increase in student exam scores.
- Dr. Overby's successful deployment of ARIS for Honors College general chemistry students led one of his fellow faculty members in the fall of '08 to implement ARIS for the College's regular two-semester introductory chemistry course offered to the general College of Charleston student population.
  - ARIS used to deliver online homework for the first time ever
  - Students could use tutorials and other online content for 24/7 homework help
  - Faculty member reported that ARIS raised student academic performance – making students complete and submit homework assignments, which helped improve content mastery, yielding higher average exam grades.