

## **CASE STUDY: SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE**

**Instructor:** Dr. Gary Kinsel, Professor and Chair, Department  
of Chemistry and Biochemistry

**Academic Objective:** To strengthen chemistry skills and content mastery  
for introductory chemistry students

To improve course pass and student retention rates

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

From its humble beginnings as the state's second teachers college – founded in 1869 with a dozen academic departments and an inaugural class of 143 – Southern Illinois University Carbondale (SIUC) now ranks among Illinois' most comprehensive public universities. A member of the multi-campus SIU system, SIUC serves more than 20,000 students from all 50 states and more than 100 countries who take advantage of outstanding academic programs as they pursue associate, bachelor's, master's, doctoral and professional degrees in law and medicine.

Approximately 600 SIUC students are enrolled each year in CHEM 200, "Introduction to Chemical Principles." Students take the course to fulfill University Core Curriculum program requirements. The course is also a requirement for many degrees offered in the Colleges of Science (biological sciences, chemistry and biochemistry, computer science, geology, microbiology, physics, physiology, plant biology and zoology) and Engineering (civil engineering, environmental engineering, mechanical engineering, and mining engineering).

As with virtually every other higher education institution in the United States today, SIUC students have a difficult time passing introductory chemistry. Too often, failure here becomes a real obstacle to students' ultimate undergraduate success – and even graduation.

Historically, SIUC student performance in CHEM 200 has been extremely poor:

- Only 45%-55% of the students routinely achieve a passing grade of "C" or better
- Rated one of the "Top 50 Most Challenging Courses Taken by Undergraduates" – out of 1,500 unique courses, this puts CHEM 200 in the top 3-4% of "hardest courses"

Further, departmental analysis of student data (from fall 1997 to fall 2001) and investigation of the long term outcomes for these students revealed a disturbing trend:

- "C" students (or better) in CHEM 200 have an average 70% graduation rate in 5 years
- "D", "F" or "W" students have an average 40% graduation rate in a similar time period

Thus, of the 307 students who did not pass CHEM 200 in AY 06-07, nearly 185 may be expected to fail to complete a degree in 5 years. Clearly, poor student performance in CHEM 200 correlates to an enormous loss of both student capital and SIUC revenue.

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**CHEM 200 with ARIS: Pilot Program History and Goals**

Faced with these dire academic results, in the spring of 2007, Dr. Gary Kinsel, Professor and Chair, SIUC's Department of Chemistry and Biochemistry, led a departmental initiative to evaluate and fundamentally re-structure its CHEM 200 instructional approach to help students develop stronger chemistry skills and content mastery. Succeeding in this goal would also enable SIUC to achieve the related goals of increasing course pass rates, and student graduation rates and timeframes. According to Dr. Kinsel, "The student failure rate was not being addressed by small changes we'd made." It was time to consider a major overhaul in instructional approach.

The course's instructional format had varied a bit over the years, but typically consisted of:

- Lecture 3x/week (using McGraw-Hill's Silberberg *Chemistry* textbook)
- Supplemental online content delivered via Blackboard

Dr. Kinsel's re-structuring of CHEM 200 centered on adding technology-based tools to increase student engagement – both in and outside of the classroom. To facilitate in-class student engagement, Dr. Kinsel decided to deploy the e-Instruction Classroom Performance System – an in-class student "clicker" system. For homework and student engagement outside of the classroom, Dr. Kinsel decided to add a mandatory weekly Structured Learning Workshop (SLW), in which Graduate Teaching Assistants (GTAs) would proctor students doing their homework, on an online homework system. This in turn led Dr. Kinsel to review the available online homework and course management solutions on the market. He selected the ARIS system, for several reasons:

- Its ability to integrate with the course's McGraw-Hill textbook
- Its convenience for TAs and instructors – rich database of homework assignments for instructors, who wouldn't have to create assignments "from scratch."
- Its ability to easily track student performance

Dr. Kinsel observes:

*"Chemistry is a problem-solving oriented discipline. Students think they 'get it' when they listen to my lectures. But when they try to actually solve problems on their own, they can't do it. And when struggling students – "D" or "C" students – get stuck they benefit from the extra support and input from a TA, as well as the ARIS system. That's why we decided to make the weekly SLW mandatory – the data shows this is the best way to make a "D" student into a "C" student."*

SIUC's goals for the CHEM 200 pilot program were:

- To evaluate the effectiveness of adding technology-based student engagement mechanisms on student learning outcomes
- To assess the impact of mandatory, proctored ARIS homework on student skill development and content mastery
- To raise course pass and student retention rates

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### **CHEM 200 with ARIS: Pilot Program Design**

In the fall 2007 semester, SIUC launched a two-phase, two-semester trial of the ARIS homework management and course content system, coupled with an in-class student response clicker system:

**“It can be stated with certainty that there was a substantial improvement in overall student performance... when we implemented ARIS and student ‘clickers’”  
Dr. Gary Kinsel**

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Fall 07	three sections of CHEM 200	304 registered students
Spring 08	two sections of CHEM 200	269 registered students

- Instructional format:
  - Three lectures per week
  - In-class response system – otherwise known as student “clickers”
  - Mandatory weekly GTA-proctored Structured Learning Workshops (SLWs) utilizing ARIS

### **Pilot Program Results:**

#### **Quantitative Impact:**

At the conclusion of the spring 2008 semester of CHEM 200, Dr. Kinsel performed a thorough data analysis of student performance in both sections of CHEM 200, across both semesters.

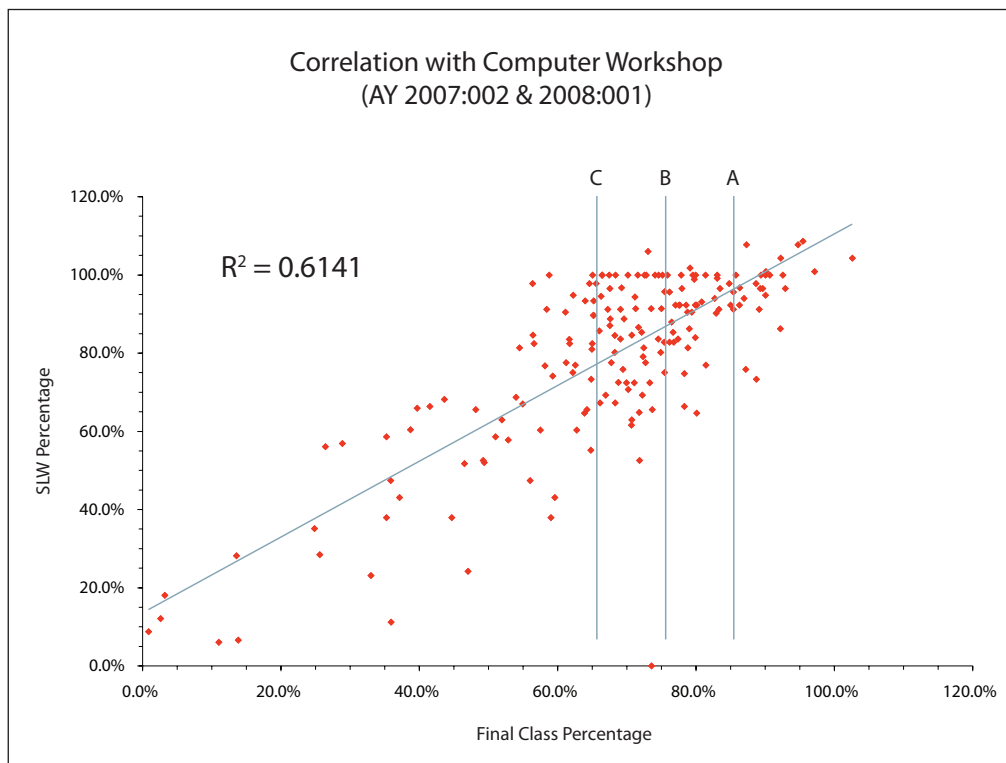
His conclusion:

*“It can be stated with certainty that there was a substantial improvement in overall student performance from the AY06-07 fall and spring semesters to the AY07-08 fall and spring semesters, when we implemented ARIS and student clickers.”*

Grade	AY06-07	%	AY07-08	%
A	81	12.7%	89	15.5%
B	108	16.9%	113	19.7%
C	143	22.4%	143	25.0%
D	107	16.7%	85	14.8%
F	119	18.6%	94	16.4%
W	81	12.7%	49	8.6%
<b>Total</b>	<b>639</b>		<b>573</b>	
<b>% Pass</b>	<b>52.0%</b>		<b>60.2%</b>	

- **Boost in Student Achievement, Lift in Final Course Grades**  
Overall distribution of student grades was shifted to higher class grades
  - 35.2% – “A” + “B” final grades, AY 07-08, up from 29.6% in AY 06-07
  - 5.6% increase
- **8.2% Increase in Course Pass Rate** (final grade of “C” or better)
  - 60.2% of students passed in AY 07-08, up from 52.0% in AY 06-07
  - 8.2% increase in passing rate = 50 additional students pass CHEM 200 in a typical year of 600 student enrollments
- **4.1% Reduction in Course Withdrawals**
  - Course withdrawal rate decreased from 12.7% to 8.6%
  - 4.1% reduction in withdrawal rate = 25 more students completed the class than have in the past
- **ARIS Demonstrates Strongly Positive Impact on Student Performance**
  - Strong correlation between student ARIS homework completion and final class grade
  - Virtually all students getting 100% on homework points got at least a “C” final grade

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SIUC Chemistry Student**

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### **Qualitative Impact:**

At the conclusion of each semester of CHEM 200, students completed anonymous post-course student surveys evaluating everything about the course, including numeric ratings for instructor, textbook, and instructional format – including the SLW with ARIS. Students were also invited to include their own comments. Fall 07 and spring 08 CHEM 200 student survey responses indicated a high level of students satisfaction with ARIS and the SLW.

- **ARIS/SLW scored a 4.14 and a 3.95** (out of a possible 5) in response to the question, “Did the questions asked in the Structured Learning Workshops help you understand the concepts?” for the fall 07 and spring 08 semesters, respectively
- **ARIS/SLW scored a 3.81 and a 4.05** (out of a possible 5) in response to the question, “Did the Structured Learning Workshops help your final grade in the course?” for the fall 07 and spring 08 semesters, respectively

Representative student survey comments included:

*“ARIS questions actually were relevant to material and helped me understand the concepts.”*

*“It was a good way to actually sit down and try the problems. Without the ARIS sets, I probably would not have done much practice.”*

*“You immediately know whether you got the questions right or wrong and if you don’t get it the ARIS goes over it.”*

*“ARIS was a good study tool for me.”*

### **Institutional Financial Impact:**

From a financial perspective Dr. Kinsel concluded that:

*“ARIS and the in-class student clicker program have the potential to deliver a tremendous ROI – both in terms of student capital and revenue to the University – with a relatively minor up-front investment.”*

Dr. Kinsel’s analysis of pilot program data revealed a strong correlation between students failing to complete CHEM 200 and failing to complete a degree within 5 years:

- 50 additional students would pass CHEM 200 in a typical academic year, thanks to ARIS and clickers systems
- 15-18 additional students would therefore obtain their degree in 4 additional years of study (assuming historical graduation rate patterns for these 50 students)
- Yields huge return to SIUC, in terms of tuition and fees over that same 4-year period