ALEKS® Case Study
Texas A&M University | College Station, TX

Course Name: Fundamentals of Chemistry (CHEM 101); Chemistry Reinforcement Module

Course Setup: ALEKS Intro Chemistry with Zumdahl & Zumdahl: Chemistry, Atoms First

ALEKS Implementation: Chemistry Reinforcement Module: Prep; CHEM 101: Lecture-based

Average Enrollment: 3000 students per term

Introduction

When Dr. Collins arrived at Texas A&M University in the fall of 2015, the students were woefully unprepared for Fundamentals of Chemistry (CHEM 101). This is because most students have forgotten much of the material learned in their high school chemistry course by the time they arrive at Texas A&M. The university did not have a chemistry placement test or remediation course, so the under-prepared students would enroll in CHEM 101 and do poorly. This led to higher D/F/Q rates.

Under the direction of the Texas A&M Chemistry First-Year Program, Dr. Collins, along with his colleagues Dr. Stephanie McCartney and Dr. Ryan Bethel, created a prep course that would help under-prepared students and reinforce long-term retention and learning of chemistry.

With help of the ALEKS Chemistry Implementation team, the Chemistry Reinforcement Module (CRM) was established in 2017 as a pre-course program aimed at solidifying the fundamentals from high school chemistry for incoming students.

ALEKS Experience

ALEKS has become a big part of the first year experience for students at A&M. Students learn the foundations of college chemistry on their own time by completing the CRM over the summer. This leads to better discussions in class and students that are more prepared and understanding of what is required of them in CHEM 101 or in CHEM 107, which is a one-semester general chemistry course designed for Engineering majors.

ALEKS has become a critical piece of the "early warning system" designed by Dr. Collins under the direction of the Assistant Provost of Academic Affairs. This system ensures "at-risk" students are identified and helped well before the first exam of CHEM 101, unlike traditional courses where students who are at-risk of failing are not identified until the first exam.

Implementation

The Chemistry Reinforcement Module (CRM) is completed by students prior to starting CHEM 101, with the last day of the CRM being the second Friday of the semester. The CRM consists of 136 ALEKS topics that cover college math, algebra, and what would be the first three to four weeks of a traditional chemistry course. There are also 36 videos created by Dr. Bethel, Dr. McCartney, and Dr. Collins that go hand-in-hand with the ALEKS topics in the module. The CRM makes up 5% of the CHEM 101 grade for all students (out of 1000 points).

A five-metric "at-risk warning system" was developed in conjunction with the CRM that allows the faculty to help students well before the first exam in CHEM 101 **(see Figure 1)**. ALEKS is a critical part of this system because of its ability to accurately diagnose a students' individual knowledge gaps in chemistry and efficiently remediate them.

Figure 1: CHEM 101 At-Risk Warning System

Number	Metric	Purpose
1	ALEKS Initial Knowledge Check in CRM	Identifies each student's knowledge of chemistry prior to starting the CHEM 101 course.
2	ALEKS Pie Completion at end of CRM	Predicts the likelihood of success in CHEM 101 based on the percentage of completion of the CRM. Students who complete: • 100% of CRM have a 85-90% chance of passing CHEM 101 • 75-95% of CRM have a 60% chance of passing CHEM 101 • <75% of CRM have a 1 in 3 chance of passing CHEM 101
3	1st Assignment in CHEM 101 (differs based on instructor)	Identifies struggling students up to this point in the course. The bottom 25% are notified by the instructor.
4	Attendance in first 3 weeks of class	Shows the commitment and work ethic of students.
5	First CHEM 101 Exam	Culmination of work in the CRM, attendance, and work ethic in the course.

Students are assigned a green, yellow, or red label for each metric based on their performance in the CRM and in the CHEM 101 course. If a student receives three "reds," which means they are deficient in three metrics, the student is added to an "at-risk student awareness" list. These students are then contacted by the instructor and offered help before the first CHEM 101 exam. Assistance is offered in the form of office hour meetings, supplemental instruction (SI) sessions, instructional assistant (IA) reviews, and meetings with the student success center.
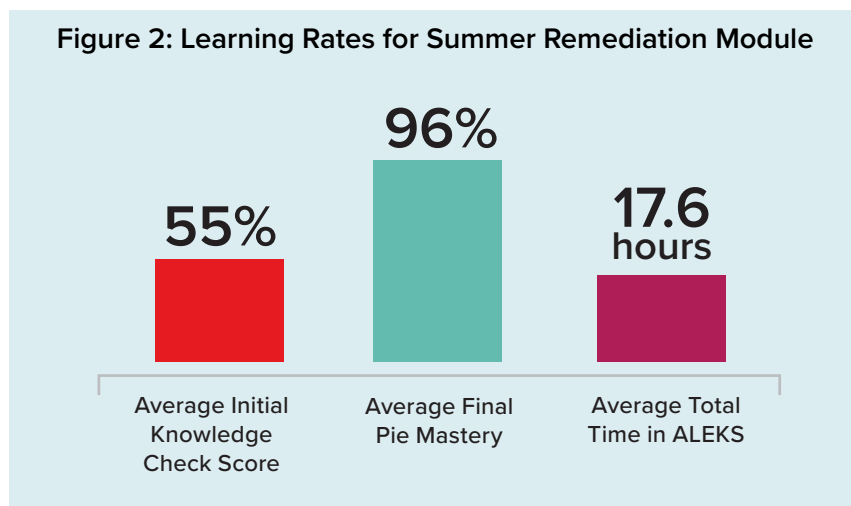
Results

For the fall of 2017, Texas A&M had 3,189 students enrolled in CHEM 101, all of who were required to complete the Chemistry Reinforcement Module (CRM). In the summer of 2017, the average ALEKS Initial Knowledge Check, or how much of the review material students knew at the beginning of the CRM, was 55% **(see Figure 2)**. The average final Pie Mastery, or how much of the review material students learned after completing the CRM prior to starting CHEM 101, was 96% **(see Figure 2)**.

Figure 2: Learning Rates for Summer Remediation Module

55%	96%	17.6 hours
Average Initial Knowledge Check Score	Average Final Pie Mastery	Average Total Time in ALEKS

Since the average student in CHEM 101 had efficiently reviewed 96% of the CRM material, which covers prerequisites and content traditionally covered in the first few weeks of a general chemistry course, the CHEM 101 course in the fall of 2017 saw about a 15% improvement in A, B, and C's. Essentially students shifted about a letter grade.

The pass rate for CHEM 101 (a grade of A, B, or C) also saw an improvement of approximately 1% when compared to the previous year **(see Figure 3)**. This translate to approximately 100 students passing CHEM 101 who otherwise would have failed without the CRM or the at-risk metric system. The D/F/Q rate (drop/fail/withdraw) improved by 0.9%.

Figure 3: Student Success Rates for CHEM 101

Term	Passing Rate	D/F/Q Rate
Fall 2016	77.8%	22.2%
Fall 2017	78.7%	21.3%

While ALEKS helps with the retention of the material, the combination of the program with other factors, especially the at-risk warning system, leads to students having a better understanding of when they need help with the material, and that they have useful resources at their disposal.

The success of the CRM and how it affected students' GPA and passing rates for CHEM 101 in the fall of 2017 is represented in **Figure 4** (see next page).

Instructor Profile

Dr. Daniel Collins teaches at Texas A&M University after receiving his Ph.D. in Chemistry from the University of South Carolina in 2012. He has taught at South Carolina, Presbyterian College, and Florida State University. His current classes are Fundamentals of Chemistry first-year courses, as well as the General Chemistry for Engineers course. He also taught organic chemistry lecture and biochemistry at other institutions.

Along with lecturing at Texas A&M, Dr. Collins has helped design and implement the Chemistry Reinforcement Module and the Recitation Program for the laboratory courses. Both programs focus on helping students succeed in first-year chemistry at the university.
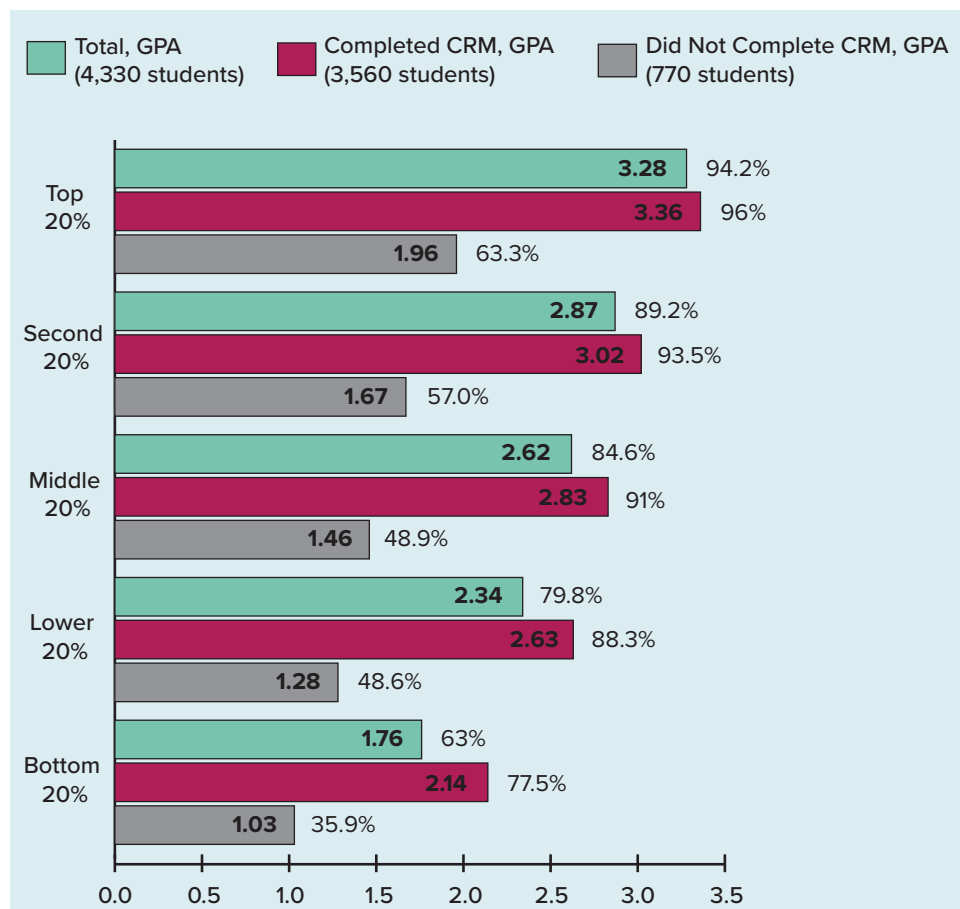
Dr. Collins is also part of Aggie Honor Council and Faculty Senate for the College of Science. Outside of his work, he is an avid sports fan, runner, reader, and Little League Baseball and Softball volunteer.

Results (cont.)

Figure 4 compares the average GPA and passing rate of CHEM 101 students who completed the CRM with a 90% or higher (purple) and those who did not complete the CRM (gray). The teal group is the total, or students who began the CRM. Each group is then divided into the quintiles (Top 20%, etc.) based on their ALEKS Initial Knowledge Check in the CRM. The passing rates are the percentages next to each bar.

Figure 4: CHEM 101 Average GPA and Passing Rates, Fall 2017

Legend:
- Total, GPA (4,330 students)
- Completed CRM, GPA (3,560 students)
- Did Not Complete CRM, GPA (770 students)

Quintile	Total, GPA	Passing Rate	Completed CRM, GPA	Passing Rate	Did Not Complete CRM, GPA	Passing Rate
Top 20%	3.28	94.2%	3.36	96%	1.96	63.3%
Second 20%	2.87	89.2%	3.02	93.5%	1.67	57.0%
Middle 20%	2.62	84.6%	2.83	91%	1.46	48.9%
Lower 20%	2.34	79.8%	2.63	88.3%	1.28	48.6%
Bottom 20%	1.76	63%	2.14	77.5%	1.03	35.9%

Students who finished the CRM had an average of 1.31 GPA point difference from those who did not complete it. The most significant effect of the CRM is evident in the bottom 20%. There was a noticeable improvement in GPA and passing rates for students in this quintile who completed the CRM, and they historically did better than a top student who didn't complete it. Even if students initially test well, completion of the CRM shows great work ethic and persistence.

While the CRM has been implemented only since fall of 2017, it has been a remarkable tool for the Texas A&M Department of Chemistry to help identify the at-risk students that enter and progress through their first-year classes. With increased involvement with faculty members during office hours, attending tutoring sessions with teaching assistants, and creation of a First-Year General Chemistry Recitation Program, students identified as "at-risk" have a better chance to pass their General Chemistry courses.

"I think ALEKS is the best online homework product on the market. While improvements can be made, and there is no such thing as a perfect homework system, its core mechanism is long-term retention of the material. That is all I can ask for when it comes to a first-year chemistry course."

– Dr. Daniel Collins, Lecturer