

## Principles of Chemistry (CHEM 1211) Course Redesign at Augusta University

Stephanie Myers

Angela Spencer

Cheryl Eidell

Jose Jimenez-Lugo

Jason Carr

Bobby Barker

At Augusta University, Principles of Chemistry I - CHEM 1211 is taught in multiple sections with different, often inexperienced, instructors. Thus, there has been substantial diversity in instructional rigor and high DFW rates. In an attempt to mediate the student issues of inequality and assist instructors, common exams were introduced in Fall 2019. Comparing Fall 2019 to Fall 2018, withdrawal rates fell from 30% to 11% and success rates increased from 41% to 65%. In an end-of-course survey students, on average, rather liked the exams (3.6/5.0) and felt that the exams reflected course content (3.8/5.0). Performance in CHEM 1212 appears unaffected.

### STATEMENT OF THE PROBLEM

Substantial growth in General Chemistry enrollment and changes in the faculty corps of instruction have resulted in a high number of new and temporary instructors teaching Principles of Chemistry I (CHEM 1211). Chemistry tends to be a field where subspecialty is important to the types of courses an instructor is qualified to teach. However, as the introductory course for chemistry majors, CHEM 1211 is one that faculty with any chemistry subspecialty is able to teach. Consequently, as experienced instructors are needed in the advanced and specialty courses, CHEM 1211 is the most effective placement for new and temporary instructors. This has led to high diversity in the instructional rigor of this course. This instructional diversity impacts DFW rates as when students perceive the professor as “too hard” or “unfair” they may withdraw or give up. In other cases, the instruction is insufficient for students to be successful in the next course, DFW rates of the subsequent course will also be increased. In addition, new instructors tend to suffer from the “expert blind spot” which makes them overestimate the abilities of the students and underestimate the amount of instruction needed for students to be successful. It is very difficult to evaluate and remediate instructional issues in a timely enough fashion to impact student success. Since it is not logistically possible to assign only experienced instructors to this class, one of the G2C recommendations was to give common major lecture exams in all sections of the course. This would help instructors know the level to target for their instruction and students would be less likely to give up because their instructor is more difficult than the one their friend has. In addition, exams will be better quality with a mixture of experienced and inexperienced faculty working together to design the exams.

## METHODS

During preregistration for Fall 2019, a common (evening) exam time was made part of the schedule for the course. Using a detailed outline of course topics, these topics were assigned to each instructor to generate questions for the test—based on the topics that were expected to be completed by the time the test was given. One instructor was assigned to compile the questions. One week before the exam, the compiled questions were reviewed by the entire general chemistry faculty (instructors teaching CHEM 1211 and CHEM 1212, including the course coordinator). Questions were reviewed for clarity, correctness and appropriateness. The entire test was looked at for length and completeness of coverage. Questions were revised or omitted as appropriate. After a test was agreed upon, a grading rubric was designed. The instructor compiling the exam made the corrections and produced a second version of the exam. The second version scrambles the multiple choice answers and changes the values on some problems. It was then sent back to the faculty for a final review and approval. Once the test was generated, the department administrator made the appropriate number of copies. One of the instructors was in charge of getting the tests to the testing location. All instructors teaching the course proctored the exam. Each instructor grades the exams of the students from their own class. Scantron data of the multiple-choice portion of the exam was collected from all sections for assessment purposes.

## OUTCOMES

### Student Response

Students seemed to adapt well to this system. Most anticipated logistical problems did not materialize nor was there a higher than usual number of students who needed to make up the exam or take it at a different time. Students were surveyed at the end of the course about their opinion of this system. Using a 5-point Likert Scale the average student response was: Did you like having common exams? 3.6 Did you find the timing of the common exam convenient? 2.9 Did you find the location of the common exam convenient? 3.1 Did the common exam accurately reflect your classroom instruction? 3.8 Responses to open ended questions indicated that students both liked and disliked the environment (including time and location) of the exam which was different than their regular class. With few exceptions, students felt this way of testing created a class that was fairer than exams given by individual instructors. There were only positive comments about the ability to study and take the exam with friends from other classes.

### Success Rates

Withdrawal rates for the four sections of CHEM 1211 averaged 11% in Fall 2019 compared to 30% in the previous fall. This trend is continuing in Spring 2020, with midterm withdrawal rates of 10% compared to 17% for Spring 2019. Students earning an A, B or C for the course increased from 41% in Fall 2018 to 62% in Fall 2019. The American Chemical Society First Term General Chemistry Test was given as the final exam for this course. Students' average on this exam was at the 46th percentile based on national norms. This test was not given in previous terms so no comparison to previous terms is available. Most students who take CHEM 1211 go on to take CHEM 1212. In spring 2020, approximately 80% of the CHEM 1212 class consisted of students who took CHEM 1211 using the common exam system. At midterm, withdrawal rates were essentially the same (4.4% in Spring 2020 versus 7.7% in Spring 2019). Averages for the first two in-class lecture exams were similar or slightly better than previous spring terms.

### Exam Quality

While there is no direct evidence that exams were of better quality, the rewrites on a variety of questions suggest that was the case. For example, in exam 4, two multiple choice questions were discovered to have two correct answers. Some questions were revised when it was recognized that a question would take much longer for the student to work than the question writer intended. Other questions were revised in response to the question, "So how are you going to grade this question?" Reviewers were also able to spot questions that might be misinterpreted by students.

## PLANS FOR CONTINUATION AND EXPANSION

Assuming Spring 2021 will be taught in the traditional manner and appropriate testing locations will be available, common exams will be officially implemented in CHEM 1212 at that time. In fact, the same major tests were given in CHEM 1212 in the 2019-2020 academic year. This has not been advertised to the students in order to preserve academic integrity, since exams are not given at the same time in the same location as they are in CHEM 1211. The department of Biological Sciences is considering the same procedure for their introductory courses, but their curriculum is less established than for chemistry. Consequently, the logistics of implementing such an exam are more complex for this department and other issues (e.g., COVID-19) are taking priority.

## LESSONS LEARNED AND POTENTIAL IMPLICATIONS

Overall, common exams had a greater impact on DFW rates and fewer logistical problems than we expected. However, there were issues with the faculty culture that we did not anticipate. Ideally, there would be complete faculty buy-in from all instructors teaching this course before implementing this type of change. However, the very reasons for the change prohibit this possibility. Faculty teaching this course are often not on campus more than a week or so before classes start. Logistical considerations, like room reservations, must be made well before the previous semester's preregistration period. Revisiting the decision every year (sometimes even every semester) when course instructors change is impractical. If this is necessary, it is likely this recommendation, and any course standardization policies, would be abandoned.

To head off issues in the future, the department, in a series of meetings, formalized some of the standard policies for general chemistry that it had used informally in the past. The use of common exams and the weight given to these exams were two of the policies agreed upon. Committees were formed to develop detailed student learning outcomes for both CHEM 1211 and CHEM 1212. It is anticipated that these will be approved by the department in future meetings. In the future, when instructors for these classes are hired, the department can make the expectation of participation in a common course structure part of the job requirements.