Mar 12th, 4:00 PM - 5:45 PM

Assessment: A Strategy for Success in Organic Chemistry

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The two semester sequence in Organic Chemistry is challenging for many students, given the voluminous amount of information to master. However, mastery can be achieved if students develop an understanding of the broad themes and principles that form the “architecture” of the discipline. Since 2006, required assessment activities, both written and oral, have been used to assess whether or not an understanding of this architecture was being developed. Students received individual feedback on all written submissions, thus providing assistance to students when their performance indicated that this essential framework was not being sufficiently developed. Representative data comparing final course grade distribution before and after the use of assessment suggest that the program is effective in promoting student success. Although this project focuses on a specific course, the implementation of a required assessment component in other disciplines could be modeled on the principles to be described.

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The study of Organic Chemistry is a challenging experience for most students, including many who have previously experienced success in other science courses. The presenter’s experience over more than three decades of teaching the year-long course show’s that typically a third or more of the students do not complete the first semester, Organic Chemistry I, with a grade of C or better on their first attempt. The fundamental premise that forms the foundation of this Assessment Program is that mastery can be achieved if students develop an understanding of the broad themes and principles that form the “architecture” of the discipline.

Since the fall of 2006 a variety of assessment activities, both oral and written, have been a required course component in both semesters of the course, though in this presentation only data relating to Organic Chemistry I have been described. By completing all activities, whether correctly or not, students can earn a 5% addition to the final course point total used to determine a course grade. The intent of these activities is that students will come to know what they know as well as what they don’t know, prior to being required to demonstrate their knowledge on quizzes and exams. The process used to judge whether or not the Assessment Program is successful in improving student performance is to compare composite course averages and final grade distributions before and after initiation of the program.
Chapter Exercises: Written exercises focus on key concepts to demonstrate skills, knowledge and abilities. Each student receives individual comments and suggestions for improvement in areas showing weakness.

“Question of the Day”: A written question is proposed to begin each day’s lecture that focuses attention on key theme of the day’s lecture. At the beginning of the next period, individual students are called on to answer the question, a strategy to encourage the use of the precise language of the discipline.

STUDENT FEEDBACK

Exam Assessment: After the first exam for the term, a questionnaire is distributed to elicit students’ perceptions of their performance. Once the graded exams are returned, their scores inform them of the level of effort required to be successful. The questionnaire also provides the opportunity to critique the exam for its relationship to the material covered and their perception of the fairness of the grading.

Course Assessment: A questionnaire at the end of the term provides the students with the opportunity to critique the course and share their perceptions of the degree to which the assessment program has been effective in promoting success in the course. This provides insights that can be used to continually modify and improve the assessment process in the future.
Comparison of Course Averages and Final Grades
Before and During Assessment Program

2003 - 2005: No activities were conducted; composite student data are used as a base for comparison. These data cover the combined data for the eighty students who completed the course during three fall semesters.

2006 - 2008: Assessment Activities have been a required component of the course for each of the indicated years. Full participation accounts for a maximum of five percent of each student’s course evaluation. The average number of students completing the course each semester is twenty five.
Composite Grade Distribution
Organic Chemistry I, 2003 - 2005
Course average = 70 %

Grade Distribution, Organic Chemistry I
Fall 2006 Course Average = 77%
Assessment Program Initiated
Grade Distribution, Organic Chemistry I
Fall 2007 Course Average = 81%
Assessment Program, Second Year

Grade Distribution, Organic Chemistry I
Fall 2008 Course Average = 69%
Assessment Program, Third Year
Grade Distribution, Organic Chemistry I  
Fall 2008  Group 1 (>80% Participation)  
Group Average = 79 %

Grade Distribution, Organic Chemistry I  
Fall 2008  Group 2 (<80% Participation)  
Group Average = 55 %
CONCLUSIONS

To what extent has there been a measurable improvement in performance by students due to the Assessment Program described here? An attempt to answer this question uses a comparative composite data base consisting of final course averages and grade distribution patterns from the three consecutive semesters of Organic Chemistry I that immediately preceded the initiation of this project.

An examination of the corresponding data acquired during the first two years following the incorporation of assessment activities into this course certainly suggests the program’s value for increasing student performance. Increases in both the percentages of course grades C or better and the overall course averages for students completing the course are clear. Additionally, course evaluations completed by students at the end of the semester indicated that a large majority of them believed the assessment activities to be a very helpful tool that assisted them in numerous ways. Particular value was placed on the written individual feedback they had received when chapter exercises were returned to them.

Thus it was rather disconcerting, once the relevant course data from the course completed this past fall was compiled. There was not only an absence of improvement comparable to the two previous years, but the data were indistinguishable from the composite data base used as an evaluation standard! However, upon closer examination that focused on the level of participation in assessment activities and the corresponding course performance, it seems clear that the learning that does occur is much greater when students take advantage of the opportunity to find out what they know, what they don’t know and what they think they know, but really don’t. It thus seems reasonable to assert that students can benefit from the Assessment Program, but they must take advantage of the opportunities offered for success to be achieved.