

## **What the College Teachers Learned from High School Teachers in MSP** **By Anthony Durante and Eric Fuchs\***

We are two college teachers, one in chemistry (Anthony) and one in mathematics (Eric), who have been on the Teaching Research Teams (TRTs) for the past two summers. In this column, we want to share our thoughts about what we have learned from our MSPinNYC (MSP) experience and working with the high school teachers.

Teachers, you may be shocked to realize that college professors don't prepare lessons in quite the same way you do. We think about the material we need to cover, and we write a lecture in which we focus on clarity, on articulating key ideas, and on relating the most logical path toward the concept we are covering. Our learning goals and objectives are rarely articulated. They are in our minds but in broad terms – such as “students should understand chemical bonding at the end of this unit.” Exams, quizzes, and other forms of assessment are constructed after the lesson.

### **Lessons versus Lectures**

One fundamental change we've made in our teaching as a result of working with high school teachers is to rethink the planning of our lessons. We now think about *student learning* explicitly. We now use a new methodology (new to us) that provides us, instructors, with a starting point to plan or to re-evaluate a course from the learner's perspective. This methodology requires us to prepare and conduct our lessons in a manner we had not used at the college level. The NYC high school teachers we worked with in the MSP program have given us wonderful instructional advice, and as a result we've changed the way we're teaching chemistry and mathematics at the college level. The methodology is well-known to elementary and high school teachers. We know this method is not new, but regrettably it is not consistently used by most of our college peers. They've told us so.

The methodology consists of a simple three-step planning approach – a backward design. First, we write out and state the objectives for each lesson; second, we create exercises or questions to assess whether the students grasped the background necessary to understand the new skills or topics stated in the objectives; and finally, we design a lesson plan clearly describing the new topics and concepts. In the end, the plan contains a mix of presentations, demonstrations, discussions, questions and answers, problem solving techniques, inquiries and scavenger hunts ... all pointed toward meeting the objectives, which we share with students at the beginning of the lesson. Our expectations on student achievement are thus clearly conveyed to the class.

### **Assessment, Homework and Quizzes**

In planning our lesson, we address student misconceptions. Besides our own experience, we rely on consultation with other instructors who, without fail, have encountered these misconceptions in the classes they have taught. In our lesson planning we allot time for students to acquire the skills through practice and skill-building exercises. Student understanding is also reinforced through independent or team-based classroom and

homework exercises, challenging students to ponder and practice key topics and relevant points.

Further reinforcement of the subject matter takes place through homework reviews and brief quizzes, which represent a significant portion of a student's grade. Because the quizzes indicate how well the students understood the topic, there must be a good correspondence between the lesson's objectives and assessment. Synchronization is critical, and the assessment must specify the mastering implied by the objective. To test if this synchronization exists, we state the objective as follows: "After completing this unit, students will be able to..." The assessment helps us confirm that the lesson's objectives have been attained.

For example, in a chemistry lesson on the periodic table, the objective might state: "Students will be able to determine the number of valence electrons and the charge of an element from its position in the periodic table". The assessment that follows will be:

a) In the blank space at the right of each element, indicate the number of valence electrons in each of the following:

Sodium	_____	Krypton	_____
Calcium	_____	Boron	_____

b) In the blank space at the right of each element, indicate the symbol and charge of the ion formed by gaining or losing valence electrons:

Sodium	_____	Aluminum	_____
Calcium	_____	Oxygen	_____

The topic above will link to a follow-on objective, which will state: "Students will be able to write chemical formulas for ionic compounds that will form between any two oppositely charged ions." The assessment then helps us determine whether the students have mastered formula writing skills.

Similarly, when working with rational expressions in a remedial math class, the objective might state: "Students will be able to simplify rational expressions by factoring the numerator and denominator." The assessment includes several exercises that help us determine if students are able to factor difference of squares, trinomials and factoring by grouping.

Fully implementing the methodology that we've learned from our NYC high school colleagues requires considerable time and dedication. We spend now significant time writing clear objectives, planning assessments, reviewing and grading homework, preparing and grading quizzes, and providing feedback to students.

By clearly stating the focus of the course in the form of objectives for each unit or lesson outlined in the syllabus, we help students understand how each lesson and assignment fits into the overall curriculum and help them acquire the skills and knowledge they need to succeed in class and in their chosen field.

### **Chemistry and Math Are Fun Now**

Although one semester may not provide the basis of statistically sound data, we've witnessed a higher level of student engagement and generally higher quiz and exam scores in the classes where we've implemented this new methodology. Students have told us that they are confident in their ability to do well in chemistry and math because they have developed the understanding on which topics to focus and of how different topics link together to form a consistent story.

For example, several first semester chemistry students investigated the relative fuel efficiencies of gasoline and ethanol in identical automotive engines. The outcome of their work was remarkable: students were able to use gas laws, fuel combustion data, and engine displacement data to "prove" that one liter of gasoline will propel a vehicle farther than one liter of ethanol. It's hard to believe that these students would have arrived at these results in a traditional college class. In math remedial classes, students who just learned to factor used the newly-acquired skills to simplify rational expressions, and to solve quadratic or even higher level equations; in a traditional curriculum these topics are covered in a subsequent class, by which time students have forgotten how to factor!

### **We Could Not Have Done It Alone!**

We would like to think that our colleagues who teach math and chemistry in New York City public high schools benefited from working with us as much as we benefited from working with them. For example we, the college teachers, did not feel bound by a sequential curriculum and were thus able to provide our MSP students with a more thorough understanding of chemistry and math and their applications than they would have obtained in a traditional high school class. We achieved that by connecting several seemingly disconnected topics, by providing the students with a "meta" view of the subject matter, and by peppering our lessons with our own knowledge and experience from the worlds of business and industry.

We would love to hear from our colleagues, the high school teachers, on the benefits *they* derived from working with us! One nice benefit from the collaborative work in MSP is understanding that in order to improve student achievement in high school and college, we instructors – and students– have to learn from each other. Thinking about the learner and taking specific steps in lesson planning helped us rethink what we do in the classroom.

\* Anthony Durante and Eric Fuchs both teach at Bronx Community College and participated in MSP in NYC Summer programs in 2005 and 2006. The authors wish to thank Pam Mills for editing this article and for the inspiration to write it, and Faith Muirhead, for making it all possible.