VIGNETTES on people’s adaptation and use of the modules in their courses

Heather Bullen (Northern Kentucky University): Northern Kentucky is a public, primarily undergraduate institution. I used inquiry-based learning modules in teaching Analytical Chemistry (40 students), Instrumental Analysis (15 students), and Environmental Chemistry (10 students). Instrumental students found the separation science module helpful in assessing their understanding and retention of chromatography material from Analytical Chemistry. The module helped to reemphasize the theory behind separations, providing a better foundation for students to build from as we went into more detail on instrument design and application of chromatographic techniques. I found the group problem sessions using materials from the equilibrium module to be very effective in helping students to understand the basics of buffer systems and acid/base equilibria.

Cynthia Larive (University of California Riverside): In the fall of 2010, I used the active learning materials on separations in my Instrumental Analysis course over a period of 2 weeks (6 class periods). This included the in-class problem sets on peak broadening and the fundamental resolution equation. Active learning instruction in separations followed 6 weeks of mostly traditional lectures on the topics of spectroscopy and mass spectrometry, with some smaller active learning assignments mixed in. The enrollment for the course was 47 students, mostly juniors and seniors. This course is required for chemistry majors, an elective course for biochemistry students, and is often suggested for environmental science graduate students. There is a companion lab (two 4-hour labs per week); the students rotate through the lab experiments in groups and the lab materials do not correlate with coverage of topics in the classroom.

Following the conclusion of the separations section, students were asked to complete an anonymous survey. When asked whether the active learning assignments helped their learning, 79.5% responded that the materials were helpful or very helpful. The same number responded that these materials helped them understand them a lot or a great deal. When asked if they would enjoy using this approach to learn about a new technique, 69% responded a lot or a great deal. From my perspective as the instructor, students seemed to have more fun in class and were actively engaged in the learning process. I plan to use these materials again in the future, but will probably supplement them with additional homework assignments to give the students more practice applying the concepts they learn using the module.

William Otto (University of Maine, Machias): The University of Maine Machias is a public, primarily undergraduate institution that specializes in Environmental Liberal Arts. We have three science majors, BS in Marine Biology, BA in Biology, and BS in Environmental Studies. I used the equilibrium and parts of the separation modules in Analytical Chemistry. This course is an elective in Marine Biology and serves students obtaining a chemistry minor. This course usually has 5-7 students enrolled. The course meets for three 50-minute lecture periods and one 4-hour lab each week, for 15 weeks.

During the Fall of 2009, I utilized the equilibrium module over a two week period, utilizing in-class problem sets 1, 2, 3, and 5. For each of these, I had the students (7 in the class) break into 3 groups for each class period. I gave each problem set at the beginning of the lecture for the groups to work on. I constantly was going from group to group monitoring the conversation and asked pointed questions if the students got stuck or if they were headed in the wrong direction. If the students got the wrong answer, I would have the students explain to me how they arrived at the answer and would point out the point at which they got off track. Other than
the first problem set, each of the sets of problems were completed in the 50 minute slot for lecture. The first problem set took 1.5 periods as the students were very rusty with their calculation of pH, so about 15 minutes into the class I did a brief review of material from general chemistry specifically for calculation solution pH. After each lecture I would give the students the additional text and had them read before the next period. I always started the next period asking the students if they had any questions, but they were always comfortable with the materials. I used the out of class question sets 1 and 3 for take home quizzes, to ensure students really understood the materials. Across the board, the students performed well on those two sets, so I was comfortable the students truly understood the material.

For the chromatography section, I used in class problem sets 1 and part of 2. The content was more in depth than I expected my students to know. We covered this in two class periods. I then utilized some hands on work with columns and a little lecture for the students to understand the basics of chromatography. I used the appropriate additional text as a handout for students to read as a complement to the lecture or to answer questions that arose.

I believe this material and approach worked very well for my small class. They were very interested in working in this style and based on their feedback I will use the material again. These students were also some of the better students in the science division.

David Thompson (Lawrence University, now at Sam Houston State University): Lawrence University and Sam Houston State University are private and public primarily undergraduate institutions, respectively. In the spring of 2009, I incorporated three weeks of the equilibrium materials and three weeks of the separation science materials into my analytical chemistry course at Lawrence University. The problem-solving format of these materials inspired me to take the materials one step further, and we actually did much of our course work in the lab so that the students could test many of the calculations that they carried out. The student’s response was strongly positive and they unanimously opted to continue in this vein for the three weeks on separation science materials.

My students responded very favorably to these materials. The flow from one question to the next is very natural. Solutions are logical and detailed. As students work through successive problems they see their own skill set and comfort level growing. This empowers and pulls them in. The group learning method builds community among the students, strengthening their commitment to the class and enhancing learning. The answers in the instruction manual do a great job of anticipating student questions. I kept asking the students if they were learning. They kept responding that they were.

Working through the equilibrium and separation science modules with my students was also helpful to me. It gave me a substantive model for identifying the sorts of questions that naturally tap into student’s curiosity and also a tutorial for writing answers at the right level of depth and completeness to enable students to have the reward of learning. These skills have helped me to develop better feedback loops based on observations of my students’ learning, and to tune my teaching in other standard lecture courses. It is a lot of work the first time through, but for me the payoff in terms of better educated students who are more deeply appreciative of analytical chemistry has been worth the effort.