My TFU Performance of Understanding gets a B- (Please!)

by John Magee

This was supposed to be a joyous story of an easy victory: a new approach to curriculum design, methodically implemented and successfully evaluated, clearly proven to enhance student understanding through the straightforward use of understanding goals, generative topics, performances of understanding and ongoing assessment. Instead it's the story of marginal progress, food for thought, and a frustrating effort to change a way of teaching that already works pretty well into a way that works even better.

The goal was to implement the Teaching for Understanding Framework in a science unit taught to ninth grade students. The chosen unit, on the molecular theory of matter, was to be taught in mid winter, giving me ample (I supposed) time to plan and prepare. I had already made some efforts to incorporate the Framework into the course in a broader way. I had developed throughlines, which were posted across the front of the classroom in the form of questions:

- How can I collect, graph and interpret data that is accurate and precise?
- What do my experimental results tell me about scientific principles?
- How can I describe and explain scientific concepts in clear, exact language?
- How can I use concepts of matter and energy to explain what's going on in the physical world?
- How are all the various topics we study in science connected to one another?
- How do I know what I know?

In developing the unit on molecular theory, the first question I asked was, how does this unit impact these throughlines? I approached the question by asking a different question: why do I want to teach this material at all? Aside from the fact that it is essential knowledge in the study of science, why include it in this course? It seemed that the unit was particularly pertinent to the 4th throughline, using the concepts of energy and matter to explain what's going on in the world. However, it occurred to me that we had already done significant work with the ideas of matter and energy; what made this unit different was that it was the first thing we would study this year that the students couldn't directly observe. It therefore was a perfect candidate for exploring the 6th throughline (and my favorite), "how do I know what I know?"

I was then able to add two more understanding goals for the unit:

- *"How does the underlying structure of solids, liquids and gases affect their behavior?"*
- *"How does heat affect matter?"*

However, at this point I began to doubt. I had little doubt about the first goal, and even felt fairly secure about the second, but was the third goal really an understanding goal? I had my doubts, as it seems as if the question invites a fairly short, rote answer. However, I was looking for something deeper: an appreciation of heat and thermal energy, and all the ways that they are transferred as matter expands and contracts, heats up and cools down, and changes state. I decided to go with it.

The generative topic became the next problem. I must confess that I find the whole topic of generative topics problematical. In one sense, molecular theory *is* generative. It is central to physics, and it has numerous connections to students' own experience (heat and cold, melting and freezing of water, dissolving of materials in water, to name a few). It also has numerous connections to critical physics topics such as behavior of gases, pressure, solutions and chemical reactions, conservation of energy, and a host of others. It is easy to find resources on the topic and to create opportunities for students to explore, develop and perform their understanding. However, there seems to be another aspect to generative topics, one of salesmanship. A generative topic is supposed to be *sexy*. Giving the molecular theory of matter a title that makes it sexy may just be more than I am capable of. In the end I settled on, "What is matter, anyway?" Not *King Lear*, certainly, but it followed nicely from our earlier units on force, mass and energy, and it led into the central question I really wanted students to work with: how do you use the things you can observe to draw inferences about the things you can't?

Having done all this preparation, it was time to begin actually teaching the unit. And here I found a difficult challenge that I can't altogether explain or justify: I'm not sure I actually taught the material substantially differently than I would have done without the Framework. More importantly, I'm not sure how I should have taught it differently.

In this short piece I won't go into the details of the labs, the lessons, and the projects. I believe that I gave the students opportunities to investigate and to demonstrate understanding. I believe that I gave them ongoing assessment. I also know that I didn't do as much in that direction as I might have done. In the end, in the press of time and the pressure to get through the unit, I fell back on familiar practices: lecture, question-and-answer, and quizzes. The students' final project was to write a booklet explaining the structure of matter and thermal energy to a younger student. The range of results -- from projects that really showed creativity (the kind of creativity that is grounded in understanding), to projects that basically repeated what was in the book, to projects that were incomplete or wrong -- was about what I have gotten in the past. I was, in short somewhat disappointed.

I am struggling with the question of how to translate the Teaching for Understanding Framework into a classroom practice that really works to create greater understanding in my students than they were getting with my former teaching approach. I have found that my old approach, which was not particularly a bad one, does not readily give ground to this newcomer. However, that is largely because the newcomer is still vague in outline. In future, when I try this again, I think the key is probably:

1) to make much more explicit use of the understanding goals; and
2) to let students know ahead of time that the final assessment will be based on their ability to explain this material to someone else, and then give them lots of practice doing just that.

I am so ingrained in the idea that one does not "teach to the test" that I think perhaps I avoid using the specific goals and ultimate assessments as a framework from which to have the students approach the material. I have always operated from the belief that, in order to force students to develop a deep knowledge and understanding of the material, I should keep the exact nature of the final assessment somewhat secret. In that way the students must have a flexible and thorough grasp of the material in order to be prepared for anything. However, if the assessment is based on an actual performance of understanding, then perhaps it is important to tell them ahead of time exactly what that performance will be.

For the time being, my performance of understanding of the Teaching for Understanding Framework is far from perfect.