Students Know More Than They Think They Know

Fred Marton, Department of Physical Sciences, Bergen Community College, Paramus, NJ 07652

One of the key challenges that I face in my introductory geology class is trying to show students who are not necessarily interested in science (and who sometimes do not have a good background in science and math) that the basic concepts we are trying to learn about are not overly complicated or specialized. To address this, I have used in-class group exercises and worksheets to introduce many topics. I want the students to use these exercises as a way of teaching themselves and therefore they are not asked to answer questions on topics that we have already spent time on (unless they have actually done the assigned reading). Instead, I present simplified scenarios or analogies that they can figure out by themselves and then I go on to explain and we explore how they are analogous to the topic of interest.

For example, to introduce the concept of radiometric dating, the students are given thirty-one nickels and one penny in a box. Once all the coins are heads-up, they shake the covered box and remove all the tails-up coins, recording the number of heads remaining, repeating until all the coins have flipped. In addition, they are asked to indicate when the penny flipped. They then repeat the experiment and answer a number of questions. By doing this, they will discover that although, on average, half of the coins in the box flip during each shake, no two trials are the same and the penny shows that any particular coin can flip at any time. In addition to their individual trials, I collect and plot all the groups' data as well as the cumulative results of all sections since I started this exercise in Spring 2012.[1]

I have found these types of exercises work well, overall. Most students do not find them difficult or confusing (though I am always working to improve and clarify the instructions) and they are simple enough that most students get the intended results and answers. The students like being able to take time during class to work together (if nothing more than to get me to stop talking; the classes are twice a week for two hours and forty-five minutes). In addition, these exercises account for 15% of their final grades, thereby giving them an opportunity to improve their grades. Most importantly, these exercises allow the students to see that many of the concepts we are covering in class are analogous to things in their personal experiences and that they are not some sort of incredibly complicated sciency weirdness.

Grading can also present a downside for the students. First, there can be confusion on what numerically is a good score (they are graded on a three-point scale). Second and more importantly, because individual work is graded, I collect the worksheets before going over the answers, so unless they immediately take notes, students may not retain the lesson as well as possible (I do return corrected work to them by the next class). Finally, the time when they are working on the exercises creates pressure on them and affects the flow of the class, given that they work in groups and may have to wait for other groups to finish before the class goes over everything together. An alternative I have considered is to have the students work together in their groups and then, prior to my collecting the worksheets, have the class as whole go over the answers. This would necessitate a different grading strategy, as some students may not be above erasing incorrect answers.

Overall, I have found that these exercises have been helpful to and enjoyable for the students. Anecdotally, students often refer to how much they liked them on evaluations, and they usually do well when they are given identical or similar test questions. Also, I try to include concepts that are reflected in our lab exercises, showing the students that all elements of the class reinforce each other. The biggest surprise for my students is when, going over the concepts, they come-up with an answer or explanation based on their own experiences and, when applying it to the geologic concepts, ask, “Really? That's it? It's obvious.”

---

1 http://serc.carleton.edu/details/images/40190.html