TEACHING PHILOSOPHY STATEMENT FOR PAUL JOHNS

In my view, teaching is a joint endeavor where instructor and student set out on a mutual journey of exploration in search of knowledge, skills, and learning techniques for a specific field. For some segments, the journey is easy; in others, a guide is needed. Many segments, though, have a path that is less clear. Here wayfarer and guide walk together using the experience, knowledge, and skills gained along the journey to overcome obstacles and problems in new and creative ways. It is my goal in teaching to foster creative thinking, to encourage students to seek understanding beyond surface level knowledge (*i.e.* "deep learning"[1]), and to help students gain the experience and skills to become the professionals that they are journeying to be.

Many of the students that I teach have ambitious career goals and will need to be able to think creatively to solve problems that they may not have encountered before. In my view, developing this ability is important, so I offer students the opportunity to enhance their creative thinking skills. Some of this is done through regular homework assignments, but I also like to use problem based learning[2], *i.e.* problems where there is no straightforward answer. The problems don't provide all of the information necessary to solve them, and don't give a path on how to get to the answer. Rather, the students need to synthesize what they already know to come up with a well thought out answer. They may need to do some additional research to come up with an answer. This process is not so much about getting the "right" answer, but rather looking at the process that they used to approach the problem.

For example, in the physical chemistry class that I taught, I asked a bonus question on a homework assignment about whether it is better to run or walk in the rain to get the least wet and how the angle of the rain might affect the answer. Since we had recently discussed the collision theory of gases, many of the students used a modified version of this theory to solve the rain problem. My students told me that they liked problems like this as it made them think and apply their knowledge in creative ways that were easier to relate to rather than the abstract topics of physical chemistry. Most of them also did very well on this question.

In part, successful mastery of problem based learning requires some ability to understand material beyond a surface level knowledge, and hopefully inspires students to a deeper level of learning. This kind of learning is difficult to foster, as it requires the students to be intrinsically motivated to learn. This is best done when the students themselves are naturally interested in a subject or can find ways of relating the subject to something that they are interested in, even if it is something simple. In one case, students found it interesting that we could calculate approximately how long it would take for someone to smell a scent that was released on the other side of the room.

While learning to solve problems is important, it is also important that chemistry students develop the techniques and skills necessary to be competent chemists in a laboratory setting. Students should be able to evaluate and understand procedures so that they can make reasonable modifications or so that they can develop their own procedures for a future project. In a physical chemistry or a general chemistry setting, developing a variety of techniques and skills is easily done by providing experiments that make use of different techniques and equipment. From my experience, students appreciate having a variety of laboratories where they get to try something new or work with new equipment. While I have not yet given students labs where they design their own procedures, this is a method that I would like to implement in the future. I envision that in this kind of lab, students are provided with some data or information as well as some leading questions to help them interpret the provided data. They are able to answer some questions, while developing a few of their own questions along the way. These questions would then serve as the basis for their experimental design. When students are able to construct their own learning, they are better able to retain what they have learned and come to a deeper understanding of the subject.

Students asking questions that are relevant and show curiosity beyond surface knowledge may be evidence that they are seeking deep learning. While it is unrealistic to expect that every student will reach

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[1] Bain, Ken. *What the Best College Teachers Do.* Cambridge, MA: Harvard University Press, 2004.

[2] Overton, Tina. Context and Problem-based Learning. *New Directions*, 2007, 3, 7–12.

a level of deep learning, hopefully a few in every class do. To give them a push in this direction, I will talk with them about how I became interested in chemistry or will try to give them a big picture overview of the journey that we will take. By showing them the small steps along the path, this demonstrates that they don't have to know everything all at once and that a topic that might not interest them immediately, might interest them later on.

Each time that I help students along the path of education, I find that we learn from each other. For students, this learning comes in the form of mastering the subject at an appropriate level and developing the skills and experience that they need in their professional lives. One way that I have been an example to students is by modeling expert problem solving. Some students have told me that they approach a problem by trying to find an equation that has all of the variables mentioned in a given problem and using that to solve for the unknown one. While this sometimes works, this is not a particularly good approach to problem solving. When presenting new problems at the board or after noticing that students aren't understanding a particular problem, I will demonstrate how I would go about solving the problem. I ask questions such as: What are we ultimately looking for? Can we simplify the problem? What are the methods that we could use to get that kind of answer? Do any of those methods work with the data that we're given? If they don't directly work, is there some intermediate method to bridge the gap between what we have and one of the other methods? After getting an answer, does that answer make sense with what we know? By modeling this process, I hope to show the students good ways to approach problem solving that they can use in their assignments and in their professional lives.

It is not just the students who learn, but I also learn from my students. My learning often takes the form of learning how to be a better teacher or better understanding how students learn. For example, after a class is over, I'll often take a few minutes to review how things went and what I could have done better as an instructor. One simple thing that I have learned is that students appreciate a brief review of the topic that we covered in the previous class, a quick overview of what is planned for the day's lesson, and how the two connect. This was not a practice that I originally used, but after reviewing classes, things seemed to be too disjointed from one day to the next. This turned out to be very helpful, not just in organizing the class, but also in getting everyone on the same page for the day's lecture. As an additional example, sometimes when reviewing what was covered in a lesson, I realize that there was an important aspect of a problem or theory that I either did not explain well or explained at too high of a level for the students to understand. As a result of my brief review, I will think about how to better explain the topic or how to treat it with the time that the students need to understand it. In the next lesson, I will take a few minutes to go over that topic again. In the instances where I have done this, the students had a much better grasp of the concept afterwards.

Teaching a class is not a perfect journey. There are difficulties and problems that arise along the way. Sometimes the students are able to proceed past those obstacles with minimal hindrance. Other times they need just a little help to get pointed in the right direction. Other times they need more substantial guidance. It is my goal that by the end of a class, the students are closer to their professional goals, have developed creative problem solving techniques, good lab techniques, and have been able to go beyond surface level knowledge.