Assumptions

Before teaching, I spent about 6 years studying chemical engineering, and one of the first things I learned in my engineering classes was to list all of the assumptions we were making in our calculations. Things like 100% yield, perfect insulation, the gases are ideal. In some situations, the assumptions make perfect sense; in other situations we're at the limit and the assumptions no longer hold. I still remember being horrified in one of my design classes because we were told to include a 30% safety factor (i.e., make all vessels 30% larger to account for any crazy expansions/explosions). I was left wondering if there wasn't a way to get the safety factor smaller- with better assumptions, perhaps?

As I get ready I start my fourth year teaching, I'm thinking about my assumptions about teaching, learning, and collaborating, and wondering- where are my assumptions valid, and where do they break down?

In some ways, I started unpacking my assumptions about teaching and learning about 4 years ago, when I joined the Knowles Science Teaching Foundation (KSTF) as a teaching fellow. With the help of my colleagues at KSTF, I've explored a variety of questions about my teaching practice over the past four years via teacher inquiry (but I by no means have clear cut answers to any of these questions):

As I've been reflecting on my teacher inquiry (meta-reflecting?), I've realized how large a role my own assumptions about teaching and learning have played in this process. Through the help of my many thoughtful colleagues at KSTF, I've unearthed some of my own assumptions. I started with the question of "How do I foster a safe, effective learning environment in my classroom?" Then I got the (very gentle and well-intentioned) pushback about "What does it even mean for students to learn? Do my students and I agree on what learning looks like?"**There were assumptions there about what learning is and isn't. For me: Learning _is_ conceptual understanding, demonstrated by an ability to apply concepts to new situations. Learning _isn't_ just a rote memorization and regurgitation of facts.** I tried giving a survey to get at what students thought about learning, but I realize that my assumptions about what learning is and isn't influenced the questions that were asked. After some frustrating class discussions, I moved into the question of "good class discussions" and had to first

unpack **some assumptions about what a good class discussion is and isn't.** (Good: everyone talks, students come to scientific conclusions on their own. Bad: Few people talk/same voices over and over, pulling teeth to come to conclusions, or students come to "wrong" conclusions.) I've tried to step back from the assumptions inherent in my questions to just get a snapshot of what's happening in my classroom (questions like "What does discussion actually look like in my classroom?" and "Who is and isn't participating in my classroom?") but **there was the inherent assumption that class discussions should lead to student learning.** I found myself thinking about whether there are points in the curriculum where lecture is appropriate and/or necessary and when class discussions are beneficial to student learning. I shifted my focus to small group discussions, but ran into the similar **assumption that small group discussions and interactions should lead to student learning.**

Throughout this whole process, I realized that I am heavily invested in the idea that students should be constructing content knowledge for themselves, and that this construction of knowledge is best facilitated by small group interactions and discussions, as well as student-led class discussions. And there were assumptions about teaching and learning embedded in all of this, such as:

> Groupwork is better than lecture (is it always better than lecture?). Student-directed inquiry is better than teacher-led classrooms (again, always? How much scaffolding should I give? When is it appropriate to step in and when should I step back? What does a student-directed classroom actually look like? When is the chaos more detrimental than helpful?) Struggle is necessary for learning (when is struggle productive and when is it counterproductive? How do my students view struggle? Should I be more explicit with them about why I let them struggle? When does too much struggle lead to students viewing themselves as failures in science?)

My assumptions about teaching and learning have affected my classroom on a daily basis (what activities I choose, how I introduce and go over content, even how I assign homework), and have affected the kinds of questions I've been asking and reflecting on for the past four years. I will tell you that I hate lecture- but I do lecture. I give a bellringer every day. Yes, I give the students time to work on it individually and in groups before we go over it, and yes, I ask the class for their answers, but I'm still the one directing the conversation and writing on the board. Isn't that a lecture, albeit a short one? And I've definitely given other short lectures on material such as how to balance equations, what a dissolved

ionic solid looks like, etc. My assumptions about what good teaching is led to mini-crises in my teacher identity. When I found that class discussions weren't really working (the way that I wanted) and when I found myself lecturing more in my chemistry class than I did in my physics class (I didn't want to be a lecturing teacher), when my students asked me for more lecture, I was left wondering if I'm just a bad teacher. I've had the fortune of having people I know and trust gently push back and help me unpack my assumptions about good teaching when I've struggled with these things.

I'm also realizing that my assumptions about the "best" ways to teach and for students to learn also influence my interactions with my colleagues. **I have to remember to step back and think whenever I have a gut negative reaction against something that another teacher has proposed. How are my assumptions about teaching and learning affecting my reaction?** I realize again and again how personal teaching is, and how invested we all are in our own practice, so I need to remember to be vulnerable and honest about my practice, even as I have strong feelings about why I teach the way that I teach. To be truly reflective (and to really grow as a teacher), I need to examine when and how my teaching strategies are working, and how to adjust them when necessary. Unfortunately, there's no "magic bullet" to education (although many education reformers will tell you that their way will do it), and I know this. I want to be more reflective and flexible and cognizant of my own assumptions as I work with others, because teaching doesn't happen in a bubble, and these conversations, even the hard, uncomfortable conversations where I feel slightly defensive, are how I'm growing as a teacher.

Assumptions are a starting point. I don't think assumptions are bad, because without them we wouldn't get very far. Trying to model all gases as real gases is unnecessarily complicated if you're operating within temperature/pressures where the gases behave more or less ideally. But I always had to be aware of my assumptions in my engineering calculations, and I usually had to double check at the end that they held up. In the same way, as I approach Year 4 of my teaching career, I want to be aware of my assumptions and how my assumptions are influencing my teaching decisions. Hopefully, this awareness will lead me to more reflective decision-making in my classroom.