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Final Reflection Paper

The Fellowship this summer has been an odyssey through the world of STEM, an exciting adventure full of new, exciting and sometimes unsettling experiences. I’ve gained a better understanding of and appreciation for technology and science in particular. Carl Sagan’s *Cosmos* hooked me from the beginning with its pithy, thought-provoking ideas. I was drawn to the sheer loneliness numbers bring (I am, after all, a math teacher): there are $10^{11}$ galaxies in the universe, each with $10^{11}$ stars or planets (Sagan 11\*); if inserted into the universe, you would have less than a 1 in $10^{31}$ chance of landing near a star or planet (11); 8B light years is halfway to edge of known universe, as of 1980 (11); 400B stars populate our galaxy (12). These numbers alone, to say nothing of the fascinating tales Sagan tells of Eratosthenes and Kepler and Newton, have ignited my curiosity like never before. Since I was a teenager, I have been drawn to the cosmos – but only philosophically. After reading *Cosmos* and *Zero: The Biography of a Dangerous Idea* by Charles Seife, I have felt compelled to learn more about the universe. This led to a greater interest in scientific discoveries, several of which have happened in the past two months: the awakening of a black hole, the New Horizons’ Pluto flyby and the news that the universe is dying. The exploding black hole was my World of Wonder: I shared with the class the analogy of a baby that threw up after being overfed. I learned that the black hole was bending another nearby star, pulling its gas into the black hole’s “accretion disk, … a ring of material … outside a hole’s event horizon” (Ferreira). This is something that simply would not have registered with me one year ago. Now, I’m excited to tell others about these awe-inspiring events and looking for ways to incorporate them into my classroom.

I enjoyed the format of our class and have already implemented some of these ideas into my classroom. I taught a group of gifted 5th, 6th and 7th grade students during two weeks that followed our face-to-face meetings. On the first day of class, I showed them the video of Uri talking about the difficult journey through the cloud as one travels from the known (A to B) and sometimes ends up in the unknown (C). Days later, students cited this powerful analogy when I asked them how they were doing with their projects and activities. They enjoyed the Today in History segment, which sparked conversations about meaningful mile markers in math, science, engineering and technology. In thinking back to the days we played with STEM, as we did with the MaKey MaKey, I incorporated the spirit of this into class; that is, I had students, as often as possible, play with math while solving difficult problems.

Students used toothpicks, paperclips, marbles, beans, patty paper and each other to make sense of challenging math problems. This made for a richer math experience for the students, one that fostered problem solving skills and appreciation.

An overarching theme of the 11 days was student understanding. From Shulman’s article on amnesia, fantasia, inertia and nostalgia to Skemp’s Relational vs Instrumental Understanding to Heath’s & Heath’s “Teaching That Sticks,” we were exposed to readings and discussions that furthered this theme of understanding. The takeaway from these articles is that authentic understanding, understanding with depth and breadth and height, is a complicated process that involves multiple viewpoints and access points – and yet it’s a process that, with the proper presentation, leaves our students better able to develop their higher order thinking skills. Each of the three articles mentioned above left a deep impression on me, but “Teaching that Sticks” offered concrete solutions to the problems posed in the other two articles. I’m already thinking about ways to streamline what I want kids to know when it comes to understanding slope, solving equations and learning how to manipulate exponents. I’ll look for ways to introduce concepts with “Huh?” prior to “Aha!” and to make math class a sensory experience as often as possible. (Note: this reminds me of positive feedback I received from students last school year. Many felt that they learned the sine and cosine curves better through graphs of spaghetti and the unit circle by making aesthetically pleasing ‘portraits’ of the relationships among angles and points.) Also, creating powerful analogies, as mentioned in Girod’s dissertation “Teaching for Aesthetic Understanding,” means thinking more outside of the textbook, which I’m excited (and a bit apprehensive) to do more often, and better.

I also see opportunities to infuse instruction with Quickfires and Worlds of Wonder, activities bursting with creativity, urgency, interacting with the curriculum and fun. Having students work in teams to create their own problem, as we did on day two, and then show videos of these problems will foster meaningful dialogue about authentic mathematical experiences. Tweaking the Cosmos Quickfire, where we grabbed a quote and found a picture, can be used for teaching exponents. I’ve long been frustrated with the confusion my students feel after a three to four week unit on exponents; in fact, I often wonder whether they know any more about the subject than they did prior to instruction. This jigsaw method – marrying the language with a picture and, of course, incorporating the rules of exponents – may make for a lasting impression on students’ minds. This can be used as an introduction to the concept or as a way to recap what we’ve learned. Employing some of what we learned at the improvisation workshop could bear fruit, too. Having students tell one word stories about what we’ve learned or interviewing them with props to cement their knowledge of a given topic, like slope, seems like it will make for a powerful learning experience. Having students attach what they’ve learned to nursery rhymes allow students to create the story that Heath & Heath discuss, which will help the information stick and deepen understanding. Playing with these ideas – and not being afraid to fail, a mindset that I had when I worked through the National Board Certification process – will bring a new energy to the classroom. My goal has been to improve instruction by 10% each year by creating richer, more meaningful learning experiences in the classroom. These ideas can help me attain a goal I’m not sure I’ve met the past two years.

The 11 days we met face-to-face offered a safe place to experiment, debate and share ideas. This has been what I’ve always wanted my classroom to be. This summer has shown me that mostly I’ve been teaching in a one-dimensional way, occasionally adding a second dimension to my instruction. The three-dimensional approach, or multi-modal learning (creating videos, songs, presentations that foster wonder and learning) that we’ve been exposed to, has opened new pathways for me to explore. This year will be my opportunity to do just that.

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