

PERSONAL REFLECTION ON A SUMMER EXPERIENCE TEACHING HIGH SCHOOL AND MIDDLE SCHOOL GIRLS

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Abstract: This paper presents personal reflections on an experience of just a few days of teaching high school and middle school girls over the summer in a STEM outreach program. The program is intended to stimulate curiosity and excitement about college in general and education and careers in STEM in particular. This paper intends to promote a deeper conversation about the purposes, methods, and effectiveness of outreach programs geared for millennial students from urban schools.

Key words: K-12 summer outreach, urban education

In the summer of 2013 I spent a few days with some high school girls from schools across Baltimore city and part of a day with girls from middle schools from the same population. Although I have lived in East Coast urban centers my whole life, this experience impressed me with a number of new insights about the challenges of education in America.

Lesson 1: **It is both exhausting and exhilarating.** This is not like teaching college, you are 'on' at all times and in this case it was almost continuous from 9 a.m. to 3 p.m. Bathroom breaks, going to your office, etc. are not possible. This was not like an extension of a 50 minute lecture, but encompasses you fully. It should also give you a lot more sympathy for K-12 teachers. The benefit of assistants and multiple eyes and hands in the classroom becomes apparent, though many teachers do have to fly solo.

Lesson 2: **You need to be flexible and adaptable with your lesson plan.** What you think will engage won't and what you think won't will. This presents a real challenge if you feel you have a particular curriculum or content you must cover. The tyranny of content is something that is experienced by engineering educators at all levels. The question of breadth and depth has been mentioned before, but bears repeating.¹ What of this will students really retain? What is the essential content knowledge? Some disciplines, such as Civil Engineering, have done a lot of work in that regard through the ASCE professional organization and creating a common core knowledge for students in the field.² There is a fine line between going with students energy or allowing them to side-track you. That is true at all levels of teaching.

Lesson 3: **You need to set clear expectations.** And repeat them. Don't be discouraged about repetition. Also think about providing key instructions and information in a variety of formats and places. This is a principle of universal educational design and helps students with different learning challenges as well as more conventional students to succeed.

Lesson 4: **You need to be active and interactive.** In some ways what you are really teaching is yourself, for good or ill. This is a truth we see in some of the best loved inspirational movies about teachers from *Dead Poet's Society* to *Stand and Deliver*. This can be challenging for people from underrepresented groups, who don't look like the typical "scientist". But it also probably explains a recent article in the Chronicle of Higher Education that presented the finding

that students often “major in the professor”.³ The professor’s passion and personality often influence the student’s decision about a major field of study. To be effective at this you need to learn classroom management skills. This is not something that they teach engineers or scientists in grad school or as post-docs. Find colleagues in a school of education. You will probably need to walk around the room, providing repetition and one-on-one instruction.

Lesson 5: The role of technology is always surprising and a mixed blessing. It was a fascinating observation that without clear rules set about technology and texting in the classroom it will run rampant as soon as students’ attentions wander. But that does not mean the solution is simply to ban the technology. It does present a challenge to the instructor. I also saw students looking up things as I was mentioning them. That provided additional feedback and engagement to the class. A lesson plan that involved a fair bit of low tech and group work and cooperation and took up a fair bit of time was not necessary when a student found a suitable app to use to the same end. Similarly, as anecdotally many colleagues have expressed; do not assume that your students are so tech savvy. Their knowledge is often quite limited. More surprising is a reluctance to explore and try things out. Another point, not exclusively about technology, is that there is a relationship between content knowledge, general background knowledge, process knowledge and the higher order skills that are often referred to. Without the common knowledge and some of the technical content knowledge, effective analysis and synthesis become impossible. Without process skills the higher order efforts become too slow and cumbersome.

Lesson 6: Be prepared. With supplies and checklists especially. You can’t rely on the students to bring in materials that they might need. Perhaps you have TAs or lab assistants who can help with some setup and supplies, but I think this is always a challenge for interactive teaching. It is much easier to revert to talk; whether you call it lecture, discussion, videos, etc. This is also why many K-12 teachers pay out of their own pockets for supplies that students may need. This is both a terrible, in revealing our lack of commitment to education as a society, and a beautiful practice, contrasting the teachers’ dedication, at the same time.

Lesson 7: There are a lot of resources out there. And don’t be afraid to look down as well as up. What I mean by that is that lesson plans that are designed for middle school can be perfectly adaptable and even quite appropriate for high school students. Not because they are bad or dumb, but because the best lesson plans engage at any age. The best lesson I did was with thin films, but creating a thin film nail polish on top of water. Everyone was captivated by the iridescence of the film that we then trapped on black card stock. There were a lot of other extensions possible to the creative and non-technical as well as to the world of nanotechnology.⁴

Lesson 8: Don’t be afraid to experiment and fail yourself. And laugh. There is always next time. Feel free to mash up the various resources you find to put forward those things you feel most strongly, comfortable, passionate about. Do not underestimate the importance of the affective domain. Learning theorists who also work in AI and Robotics have looked at the idea of various axes of emotion that effect learning⁵. One needs to be excited rather than bored, confident rather than afraid, supported rather than only critiqued.

Lesson 9: Cultural Flexibility is crucial for student success. That may not be a common term in Engineering Education, but it became clear to me that one of the biggest barriers to ultimate success for these girls in pursuing college was a lack of cultural adaptability. Fair or not, the unspoken social norms in a college classroom vary from culture to culture, country to country

and are a big advantage for students who come from privileged socio-economic groups. Successful students who learn that bi-cultural flex can then apply it to become multi-cultural. We all carry multiple identities and ways of speaking in group and out of group. Knowing how to navigate social systems and norms just adds another layer of stress, fear and unfamiliarity onto students from underrepresented groups who are pursuing STEM.

Lesson 10: Bring in Current Events, Culture and other Non-technical topics and concerns.

After your own experience with K-12 outreach, you may also want to become more involved in the standards and other things that are going on in the K-12 universe. We need to think about education more holistically, so that it is really a K-16 partnership and college does not become a discontinuity for so many students. It is not about teachers “doing a bad job”. Again, I think we need to review as a society what are goals are for all young people graduating from high school today. We through around words like critical thinking and higher order thinking skills, but we need a critical evaluation ourselves of what that means and looks like, even at the college level. A book *On College Teaching* is an excellent introduction to ideas of logic and process.

Lesson 11: Reflect on your experience. Examine it for change for the better. Asking what went right? what went wrong? What shall I change is not a bad thing. This is part of an examination we should do at all times.