Consider Doing the Lab Before Lecture in STEM Classes

[redacted],

I think we can retain more students in STEM related courses if we modify our teaching methods a bit. I can remember taking classes at UCLA and not ever understanding the purpose of the courses, even after I graduated. My suggestions below are a response to Dr. [redacted]'s appeal to improve our retention and success rate at the community colleges. Prior to your Strong Workforce meeting, I shared the same ideas with [redacted]. Earlier this summer, shared the same ideas with Dr [redacted].

I have observed that there is a large disparity in the exposure students have to technology and to industry practices. For example, some students have family members to explain what a transistor is and what it does and why it is important to learn in the future, while other students do not. Here is a specific example. One student in my CAD class said that his grandpa was an architect and he has been showing him the trade with industry examples and field trips since Jr High School. This student was exposed to CAD in Jr High.

We can't provide an inspirational, knowledgeable grandpa to every student, but we can bridge the gap of exposure to technology by taking time to demonstrate what we are teaching.

First generation students often do not have the inside track of how to develop foundation skills for a given technical discipline or even what skills to develop. Dr [redacted] insightfully observed this fact in one of his presentations to [redacted] faculty. Students don't even know why these skills are needed. I was in this place back when I started college. I see this gap in my classes at [redacted].

I decided to address this disparity while I was teaching college classes. At the time , most if not all of my students were first generation college students with a lot of challenges. I had a class in semiconductor devices to teach. After reading through the lecture materials and the theoretical jargon, it brought flashbacks of how disillusioned I was when I first took a similar course in college. I changed my teaching approach to help the students to get a grasp for what is being taught and why. **I did the lab before the lecture**. I piled some electrical components together in front of class and told them what I was about to do. Then I assembled the parts to make them to do something practical like control the speed of a small DC motor. I took electrical components apart and said they will have to assemble the same circuit at the end of the class. After the lab, I gave the lecture to explain the theory of what was done earlier in the lab. After the lecture, I required the students to construct the same circuit and to verify that it works.

I did this the same type demonstration with a homemade AM radio transmitter and with a transistor radio as a receiver, with motor controls, with a hand crank electricity generator made from a drill motor, and with computer graphics for math applications. The computer graphics demonstration is where the "Coding CANVAS" idea originated after I learned to code back in the 80s when I did dynamic simulations for missile systems. If you recall, "Coding CANVAS" uses computer graphics to demonstrate a practical application for learning math and computer science.

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The sub-scale robot is an extension that industry experience that I gained in the 80s. It is another example how we can do a "lab before lecture" pedagogy to show CAD design, coding, computer graphics and math and electronics with one tool. Last week, one student in my technical drawing class asked me how radios worked. He knew how sound travels through the air, but he did not understand how radio waves travel. I am going to bring my homemade AM radio transmitter to demonstrate this.

In high school, I saw no reason for the quadratic formula, distance formula or factoring. We seemed to focus on a finding ways to slice and dice, and organize numbers for no apparent reason .

I was looking through the CID course outline of records and I had the same anxiety from my initial exposure to the topics at UCLA. Take the following examples as a case and point:

1)**C-ID Number: Engr 120, Title**: Introduction to Programming Concepts and Methodologies for Engineers. Course content jargon...Elementary functions, Array definitions and operations, Pseudocode, flow charts, Variables, expressions, order of operations

2. **C-ID Number: Engr 260**, Title: Circuit Analysis. .. N-type, P-type, PN Junction Diodes, Bipolar Junction Transistors....

These course content outlines are filled with technical jargon that is over the head of the students who will be in the Pathways program. Without a "grandpa" to explain what is happening in regular everyday language and without some practical experience from the industry, I would expect many students to fall away from these Pathways courses and even from many in the CTE courses, unless we bridge the gap with some different pedagogical strategies. Only those with connections to industry will have a fighting chance to survive these classes, unless there is some type of intervention. Been there...., done that.

Collaborative activities are less intimidating than competitive ones. We should consider starting collaborative events as recruitment tool for high schoolers and to demonstrate our disciplines, similar to FIRST Robotics but low cost and practical.

We should consider some collaborative web based events as a tool to assist high school students and HS teachers. We should consider "lab before lecture" pedagogy in the college classroom as means to retain students and as a means to guide them into industry.

The web is a useful tool to bring students up to speed. See this website as an example: www.tutorialspoint.com

tutorialspoint.com - Text and Video Tutorials for UPSC ...
www.tutorialspoint.com

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Free Jython, Financial Accounting, text and video tutorials for UPSC, IAS, PCS, Civil Services, Banking, Aptitude, Questions, Answers, Explanation, Interview ...

Forrest Mims III has lots of projects that are useful for a "lab before lecture" pedagogy.