

Education and Engineering: What I Learned by Teaching

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Dr. Johnson

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*To the optimist the glass is half full
To the pessimist the glass is half empty
To the engineer the glass is twice as big as it needs to be*

Introduction

I have heard it said that you can use a joke to break the ice. Of course, picking the right joke or anecdote for the situation is important. Stop me if you have heard this one.

A doctor, a priest, and an engineer are all playing golf. After a couple of holes they come upon a foursome in front of them who are playing terribly slow. The group ahead of them is taking much longer than is to be expected and the three men are getting frustrated with waiting. The doctor flags down a passing greens keeper and asks him if there is anything that can be done to speed up play. The greens keeper tells the men that the foursome ahead of them are a group of former fire fighters who lost their eyesight saving the clubhouse from a fire and now they are welcome to play whenever they want for free. The doctor feeling suitably chastised says, "That's awful. I will talk to a friend of mine who is an optometrist and see if there is anything that can be done". The priest, also feeling a little guilty remarks, "Yes, and I will say a mass for them and pray for the restoration of their sight". The engineer is silent for a moment and then turns to the greens keeper and simply asks, "Why can't they play at night?"

Aside from being mildly amusing this anecdote also serves a point. It is a great example of what it means to be an engineer. A problem is presented and while the priest and the doctor provide solutions, it is the engineer who sees the problem from a different viewpoint and immediately offers more viable solution than the others. If there can be a moral to the story it is simply that engineers think a little differently than others.

This is to be expected. Comments are often made about how it takes a different type of person to be an engineer. The general public sees the stereotypical engineer as a

nerdy type of person, quick at mathematics, who would rather do schoolwork than socialize. While many feel that there is little truth to this, it can be explained. Engineers are seen this way sometimes as a result of their educational background.

Learning to Learn

How many times has the average engineer heard the comment “Wow, you must be smart.” upon telling another person what they are studying and majoring in? This perception comes from the fact that many engineering classes are seen as being very difficult by those who are not in them. Much of the subject material that an engineer learns as an undergraduate is so much different than that which a business or a communications student is learning that it seems almost like a foreign language. Perhaps this material in engineering classes is much easier for those who choose to be engineers, but it could also be that they have gotten used to it.

In taking the entry level engineering classes I realized that material that seemed difficult a week or a month prior would seem so much easier, and that after finishing a class I would wonder at how difficult it seemed at the time and how easy in retrospect. It was not until recently that I realized that this was because I was learning how to learn the material. The facts and formulas were trivial compared to the fact that I was training my mind to see how to approach problems and view them from an engineering standpoint. Some students naturally learn this type of perspective very quickly, while for others it is much more difficult.

The early classes in engineering teach fundamentals. Classes such as statics, mechanics of materials, thermodynamics, and fluids are considered to be necessary for

almost every engineer. It is in these classes that the students learn how to learn engineering. The fundamental classes give a broad insight into each discipline demonstrate to students how problems in each are to be looked at and solved. Learning how to learn these techniques is perhaps more valuable than learning the details. It is this ability, which will allow the student to adapt to any workplace situation and examine different problems with confidence.

Learning to Look

A professor I had last spring told a story one day in class that I think about whenever attempting to solve any problem. It was a short story about how he was hired to provide a solution to an office building that had too few elevators for the people wishing to leave all at the same time. The waiting for the elevators at closing time was less than desirable and so a solution to this problem was needed. Rather than spend a great deal of money for more elevators, or stagger the workday, the engineer decided to put mirrors in the halls. The problem was solved.

The reason why this provided a solution was because the problem was not a mechanical, physical, or economical problem, but a human one. This serves as a reminder to me whenever I attempt to solve a problem. I try to remember to look at each problem with a fresh mind and before solutions come to mind ask myself what the nature of the problem really is. Finding a solution is almost easy once the question is understood.

I feel that this is the second step to an engineering education. Understanding engineering principles and how to learn them are the first step, and learning how to look

at problems is the second step. Truly understanding an engineering problem means that the ability to see the nature of the problem. This means that the problems might not just be simply an engineering difficulty, but also have implications in economics, politics, and other of the social sciences. Learning to see this is hard and takes time. Inevitably there are instances when the engineer is wrong.

In many ways this is a change of perspective. Looking for a good solution to any problem requires that the engineer attempt to see the problem from every angle. This goes for the solution as well. Asking questions about what the proposed solution will accomplish for different people is a good way to go about this. If a problem is understood, then the solution should be much more apparent as well as what it will mean to different people. Sometimes it is all in how you look at it.

The Last Step

The last step in an engineering education is experience. This does not mean that an engineer cannot do good work when they first are on a job, but it does imply that first-hand knowledge can be more valuable than book knowledge. Experience comes with time. I feel that this is the final step in an engineering education because there have been several times when a solution to a problem has seemed practical enough on paper would just not work in a real life situation. While the creativity and imagination that are required to see a situation and a problem from several different angles are important, there are times when they simply cannot replace real world experience.

My Role in Engineering Education

The goal of this paper was to write about what I have learned by assistant teaching ENBE 454. While I have learned much about the content of the class in attending lecture, I feel that I have learned more about teaching and the role of education in engineering. A few of these thoughts have been presented in this paper thus far, but I would still like to talk about my role in this educational experience.

I am a Teaching Assistant. This has been the first time that I have ever been in a situation such as this and I have made many mistakes. I have helped students with their homework more than I should have on occasion early in the class. I have tried to help the students with their questions and not known the right answer to their questions. Finally I have answered questions for students and been flat out wrong in the answer that I have provided. Sometimes mistakes are necessary to learn.

In making these mistakes I have learned that to help a student work through a problem by leading them along does not help them in the long run. Far too often students are looking for “The Answer”. They do not understand the question being asked and only want to receive the credit for their work and effort. In providing too much help for the students and leading them to “The Answer” the student feels satisfied that they have completed a job-well-done on their assignment. This is not the case. The notion of “The Answer” is a flawed one, especially for an engineer.

As I stated earlier, the solution to a question has no meaning if the question is not properly understood. I soon learned (with help from Frank and through observing some other Professors at work) that helping to explain the problem is much more beneficial even if more difficult than leading a student to the solution. In explaining the problem

and allowing the student to consider how to go about solving it helps to show the student the manner of thinking that is required solving other problems like it. I have found myself often times telling students to ignore the numbers that are provided and to ask themselves that the problem in the book is really asking. Asking questions is a good technique for this. I have noticed that students might know the answer already, and are only unsure of themselves. Having them talk it out reassures them of their ability and their confidence in their work. Even if they end up getting a numerical solution wrong, their methodology might be sound, and like I said, sometimes mistakes are needed to learn.

Confidence is another important factor in my role as a teaching assistant. When I realized that I either did not know the answer to a question that had been asked of me, or worse, I had given a student a wrong answer, my confidence was shaken. The fact that the questions being asked were difficult and that many other people had made the same mistake did not help to assuage this either. The two lessons that I learned from these experiences are valuable in more areas than just teaching.

First I realized that I was fallible. Of course I had known this all along since there have been many, many, many times that I have been wrong in the past. This realization was unique in that I realized that if I was fallible in the position I was in (as a TA), then others were as well. People make mistakes. Mistakes can be learned from. It is part of the education experience.

Second I realized that I had to be confident in helping others. I had to be confident that I could help them in whatever way they needed and I knew that this confidence must be visible to them. Self-confidence is important in teaching not only in

that the students will put more trust in your ability, but also in speaking to the class. The more confident I felt, the easier it was to go through the lab or over the quiz with the class.

Preparation is another aspect that I consider to be vital. Making notes prior to a class that I must lecture in, or reviewing material that might have given students trouble not only boosts the confidence that I feel to be important, but it saves time as well. Time wasted in looking up material, or wasted in remembering all of the points I wanted to touch on is time wasted for the students. It is not fair to them to waste their time. I should be efficient not to save myself time and effort, but to help others see things more clearly.

Finally the last thing that I feel to be a valuable part of my role in teaching is my experience. Obviously I do not have a great deal of this with everything in the real world, but I have taken this before and I feel that I can help others by telling them what I know. Telling a student that making a timeline to follow when working on a project helps them spend the right amount of time on each section is something that I feel may help them. Of course this is given as advice and can be ignored. In a way my helping anyone with a homework problem, problem with a group member, or a problem with a project stems from my experience. We both have the same resources at our disposal and the only difference is that I may have had worked through something similar before.

Conclusions

Teaching is hard. I know this now in a way I would never had if I had not had the opportunity to do help with this class. I think that the material is only half of the difficulty. The greater half lies in the ability to communicate to another person to help them see something from your point of view. This understanding is what they seek and people who are good teachers are good at helping others understand. Every teacher I have ever learned from has a different technique and style that stems from their personality. I feel that this is important.

It can be argued that anything that is learned in class can be learned from a book. For all I know this could be true, but I disagree. The human factor in the education process is invaluable. Learning is not always easy and every person learns in a different way. To think that any two people can read a book and take the exact same thing away from it is asinine. The human factor in teaching allows for this in the notion that person is versatile and explains what they know in more than one way so that understanding might be reached.

Finally, I would only like to remark that through teaching we learn something. No man is an island, and when interact with others we inevitably take something away from this interaction. In helping to teach others I have learned all sorts of things. I think that people learn faster when they work together. (This is why I think that the homeworks should be done as a group, especially when there is a difficulty with any one problem). In explaining a concept to a student I often have to try to explain it in a different way than I learned it. This spin on the concept increases my own understanding

and changes my perspective and makes me think that there just might be another way,
and after all, this is should be what I am striving for as an engineer.