So Where Is the "Real World?"

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This happens to me almost every term that I teach. I get very excited about some aspect of electrical engineering (complex numbers, Maxwell's equations, physics of devices, . . .). Then, right at the moment of my excitement, while I am talking about the beauty of the utilization of the concepts, there is always "the" question: "So, do we really need to know these in the real world!!!!????" In this short article I would like to address a couple of important items related to this question.

Many of my colleagues do not like this type of questioning. I personally don't mind it. While it can be the most anticlimactic moment of the lecture, over the years I have learned to love such challenges. In my opinion, the students are questioning their education, determining their needs, and challenging the status quo of their field. These are great steps in becoming self-learners and that is what the whole education system is all about. Indeed the question can show that the students are trying to look into the future and see what they really need to learn. These are all great and wonderful attempts and we should have our hats off to those types of questions. However, sometimes the problem with this particular question is that the students, in a few cases, are not really trying to know what to learn, but trying not to learn what they have to. My experience shows that the students' curiosity is the best asset for educating the class about many important and related issues.

I also believe that there are two important messages in the questions. First, we would like to study only what we absolutely have to know (based on a very narrow vision of what the "real world" is). Second, the university is not a part of the "real world." As the reader can see, when such questions arise I have to take many tangents in the lectures to explain important items that need to be addressed. In this article I will address these two major issues, hoping that many of the readers will let me know what they think.

1. What should we learn and what should we not learn?

During my years as a student, I also had many similar questions. However, at that time we did not even imagine posing a question like this. Perhaps we trusted that the system (our faculty and external departmental advisory board) knew what the students needed to study and know. While it was hard for us to see the reason for learning the abstract, and maybe theoretical, subjects, we believed that if other engineers needed to know them, so did we. I also remember that some of my colleagues, only in our study sessions, would say, "I am going to be an experimentalist, therefore I do not need to know all of the detailed theoretical understanding. I will not need that in my future career." That sounded logical at the time to many people. However, I always believed that we all should know what are considered the fundamentals of our trade—even if they are esoteric, even if they are hard, and even if my co-op position did not use them and many

of my co-op colleagues told me they were not important. My experience shows that those who do not learn in school will need to learn later in order to advance their careers. Sometimes when we are students, we only focus on our very limited perspective of the discipline that we are studying. No one really knows what they need to know in the future, the best bet is to become a self learner and practice as much as you can. Perhaps the following example will also provide a helpful point of view.

Let us imagine that we are in the first year of medical school. Medical students also take many classes and labs. They go through rotations to get practical experience. They keep learning, reading, thinking, and relearning while in rotation and later while practicing medicine. One of the tough classes they have to take in the first year is molecular pharmacology and biochemistry. What do you think will happen if, during a biochemistry lecture, a confident and "cool" student asks the professor, "Well, I want to be a cardiac surgeon—do you really think in the 'real world' I need to know this?" I have had very few friends who have dared asked similar questions. It turned out that in all such cases the professors doubted the seriousness of the student and started to doubt their ability to become a professional doctor. I agree that we need to question everything and always encourage students to never stop questioning. However, I also believe that when a group of faculty, external advisors, educators, and professional engineers get together and approve a curriculum, they probably have a good idea why each student has to take the subjects. We should trust such a group more than a few scattered examples of people in very specific specialties that claim something is not needed.

2. Where is the "real world?"

The other issue that I would like to address is the fact that many students, and even professional engineers, do not believe that the university is the "real world." They believe that the "real world" is a place outside the university where most of the knowledge gained in the university setting is not really useful. So academics like myself have to ask, where is this "real world" and why are we not a part of it?

I have been searching for the "real world" for a long time. In the last decade or so, I have had the opportunity to be a student and to work with different industries, different clients, various engineers of great talents, and a number of fine and capable business leaders as well as some wonderful students. I have come up with the conclusion that the "real world" as opposed to the fantasy world or "non-real-world" is not the right terminology to use.

When we use the term "real world," what we really mean, indeed, is the "commercial world." Let me guarantee you that we in the university are also a part of the real world, but perhaps with different constraints than the "commercial world."

Perhaps what we mean by the "real world" is the environment where professional engineers, technical staff, and business leaders are working together with a focus on the market need trying to solve practical problems. Practical problems are problems for

which there are paying customers! Should we call such an environment the "real world?" We should not forget that there are many problems with paying clients that are addressed in the universities. These clients include national funding agencies as well as large and small companies who would like to utilize the expertise of the professors for research and investigations. Consequently, I believe the universities are also in the "real world," but their focus is not the commercial market-oriented projects.

What about the "commercial world"—The world where companies survive based on the quality of their products as well as the price? In such places, things are judged by the contribution to the bottom line. If we are working to be profitable and we are contributing, we will be on the team—otherwise we have to move on. In such environments, there is very little tolerance for mistakes. If we are asked to do something, we need to learn fast, use our experience, and finish the job. No one cares how much or how long we worked, and there are no partial credits. In the commercial world, only the final working product is of value. Perhaps we can get a consultant, but we will be responsible for the outcome. It is up to us to know if the consultant is the right person and is trustworthy to deliver. For most of the working engineers, the "real world" indeed means the "commercial world" of the industry, where inefficiencies will lead to loss of market share and victory of the competitors. There are people who believe we should conduct our classes based on the commercial world demands and constraints (strict deadlines, no partial credits, and so on). I do not think that is the best approach for the academic environment.

In the university and academic environment, things are slightly different. We need to question everything from the foundation and come up with new ways to learn more effectively, new ways to view things more clearly based on our understanding of the fundamentals and our vision of the future. Almost all of the professors are engaged in creative works. We are all conducting research and are working with student projects. The students need to be trained to think critically and creatively, gain enough confidence to work on new subjects, and get to the depth of the material. By definition of research, the universities have to constantly work on new frontiers—the frontiers that are not clearly known. So we need to try to learn fast, question everything, and come up with hypotheses, theories, and new ways of formulation. As a result of working in research areas that are not fully developed, there will be mistakes, and we need to learn from the mistakes and keep going. This is the process of learning and what is meant by education. Indeed the process of being able to think critically, suggesting creative ways, and being ready to try, fail, learn, and try again makes the academic world so special and not a part of the "commercial world." We were meant to complement each other.

I guarantee you that the universities are as real as it gets for those involved. While cost, profit, inventory, competitor, market share, and all of the non-engineering hurdles haunt the commercial world, the academic environment is constantly challenged by the ability to tackle areas that no one has conquered before. The academic goal is being brave enough to try areas that are difficult for an overwhelming majority of the technical people, and knowing that by hard work, creative endeavor, and systematic approach, great achievements are accomplished. So as you can see, both the competition and reality

are out there in academia, but the process and evaluation is not the same as in the "commercial world."

So, how updated should the university classes be with respect to the "commercial world?" I hope that you remember what we have discussed before (teaching vs. educating, and teacher-centric vs. learner-centric concepts). I would say that since in the universities we are in a learner-centric environment, it is as much the students' responsibility to make sure this is a part of the practical as well as the commercial world as it is the professors'. I encourage all of you to look into your intentions when you think about the "real world." Perhaps realistic examples—true industrial cases and problems—can make your experience at the universities more beneficial and not just simple problems with highly mathematical content. How do we get there? As students, you should be excited to learn and work toward getting to know the depth, the practical side of the theoretical formulations. You should help the class to learn and be the best. We need to work together as student-faculty teams to make sure the quality of our education, our enthusiasm, and your critical thinking skills are maintained, dynamically developed, and always improved.

In the final analysis, universities are not trying to only prepare you for industry, the "commercial world;" nor are we only trying to prepare you for graduate school. Our goal is to provide you with a knowledge base to appreciate and understand what is needed to be electrical or computer engineers. We hope to create excitable, dependable, and creative thinkers who know the fundamentals needed for the EE and CprE world and know enough about the wonders of technology and the true culture of the modern times to be able to work in the related areas and learn, grow, and create what is needed to be successful in their chosen careers.

I hope we all work hard, learn the best we can, try to expand our knowledge base, and try to follow up with the realities of our field to make our experience within the university as "real" as it can get. Where do we find the "real" issues that are engaging engineers of our time? The easiest way is to follow various publications in our trade organizations. The largest organization for us is the IEEE, where thousands of engineers with similar interests are working together. You can keep up with the knowledge base by keeping up with IEEE journals that appear in all levels with various sophistications. As a part of the university system, you have access to all of them by following the link through the ISU library (http://ieeexplore.ieee.org/Xplore/DynWel.jsp).

Finally, for those of you who would like to join the dynamic industries in our area, may the realities of your university years and your great experiences help you gain great success in the "commercial world."