The Winning Team

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Preparing to meet the challenges of globalization demands new approaches to bioengineering education. In a previous editorial (Johnson, 2008), I expressed the view that the fittest for survival were those who were generalistic, versatile, and creative. Of course, this may always have been true, but globalization is rapidly expanding the choices for bioengineering service needs. With about 400,000 engineers graduating per year in Asia, compared to 75,000 annually in the U.S., the number of qualified engineering practitioners in the world outside the U.S. will soon be overwhelming. Intense engineering tasks of a routine nature can be accomplished almost anywhere with global communications what they are. So, it doesn't seem productive to try to compete with skills possessed by huge numbers of other engineers.

Although it was previously asserted (Johnson, 2008) that medical and biological engineers, because of their relatively broad range of interests, are positioned to take advantage of modern technological trends, changes are still necessary to assure a future for our graduates. Goldberg (2008) has written that the engineering curriculum is broken, and it needs to be fixed by wholesale reformulation. The Cold War curriculum that emphasized math and science at the expense of creative thinking should be trashed. In its place should be the skills that future engineers will need to survive and thrive. He names analytical ability, creativity, and communication as three of these, which together he calls qualitative thinking. The global economy places a premium on creative engineering activities performed locally; routine engineering services can and will be supplied from

elsewhere. We need to educate future engineers by preparing our students to conceptualize, create, and communicate.

Jerry Theodorou (2008) expressed it differently. He wrote that:

> ". . . . I've found that the key to staying creative is inductive logic. If one reads widely with an uncritical eye, processes information from unlikely sources far afield from one's area of "expertise," and manages to maintain curiosity and awe of a child, one increases the chances of seeing patterns and identifying connections that would otherwise remain invisible."

He goes on to say that:

> "Deductive reasoning, in which truth and solutions flow only from the proven and tested, often serves as a drag on creativity."

Engineering designs, those that are truly innovative need both induction and deduction. The induction comes at the very beginning, as a new idea takes shape and the concept of the product is just being born. This is the creative part of engineering, or the essential art of engineering practice.

Deduction is needed when an engineering concept is reduced to reality. Calculations are used with well-established knowledge to ensure that the design succeeds. No product should ever be attempted if the parameters are not all known. Deduction, or interpolation, of known information is necessary to avoid probable failure.

So, both being necessary for a successful engineering practice, are we doing right by our students? I am quite sure that engineering science and mathematics courses exercise and enhance left-brain skills. Routine problem solving becomes familiar, if not

automatic in these courses. Engineering design courses, on the other hand (or is it the other half-brain?) emphasize and exercise creative right-brain skills. General education courses should be chosen to stretch thought processes and develop new neural connections. They lead to more than just new concepts—they can lead to new paradigms of thought. Imagine, for example, Bach's Toccata and Fugue in D Minor suggesting new ways to present information. Imagine, also, an engineer so assured of her communications skills that she can sell the idea to others. Voilá! a successful engineer of first magnitude.

But, in case we forget the competition, let's take note of the fact that in India, too, soft skill training has drawn attention and is beginning to be seen to be important. While many engineering graduates in India have state of the art technical skills, only one in four is considered to be employable by multinational firms because their interpersonal and communications skills are poor (Singh, 2008). They cannot fit into a cosmopolitan work environment.

Enter Dale Carnegie training, and everyone metamorphoses into hand-shaking, smiling, glad-talking bundles of self-confidence. Competition was always very important biologically, but competition in the global arena is becoming much more intense.

The Red Queen principle, "It takes all the running you can just to stay in the same place," (Carroll, 1865) applies to all bioengineers in the 21st century. Hard running requires the best well-rounded individual we can produce. Winning the race requires a fair advantage, and that advantage can take the form of location, imagination, communications skills, absorbing free-thinking attitudes from the local culture, or any

combination of these. That advantage will not likely come in the form of technical skills better than others in your class.

I have seen this over and over in my own students. Some students know exactly how to solve a heat transfer problem or design a simple electronic circuit. For others, it's a struggle. But let those others give an oral presentation, and their true skills shine. Arlo Guthrie said that "everyone is good for something," and it's true. I fully expect the "C" students in my class to become the millionaires, or the politicians, or the movers and shakers of the world, while the "A" students become underpaid professors like myself with very limited influence. Who will be most successful? By many measures it could be the "C" students.

Who do you hire to be the baseball team's batting coach? Is it the natural hitter, the guy who could hit home runs with his eyes closed? Or is it the guy who always struggled with hitting, who had to analyze and re-analyze his batting stance and his swing? I would hire the struggler, because he is the one who could teach batting skills to others. The first guy would expect everyone to be able to bat successfully with their eyes closed.

So it is with our future bioengineers. We need creative engineers capable of original thinking and also capable of communicating their ideas to others. Hire the best coaches, and give them a simple job to do: make our guys and gals be the winning team.

References

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