How to improve India's engineering education

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Few years ago, five M.Tech students of agricultural engineering from one of the top agricultural universities of Maharashtra came to our Institute for doing 4 months' internship.

One day during their internship, we got some visitors to our Institute to whom I was showing our electric trike. While running it, a knob came off from its switchboard. In order to fix it I asked one of the interns to get me a plier. He brought me a spanner instead! He did not know the difference between the two.

These students during their B.Tech and M.Tech had never worked with their hands or had even seen farm machinery and did not know anything about simple workshop equipment. They had passed engineering examinations without learning anything of practical value and their goal in life was to become agricultural officers in banks!

Similarly, few months ago I got an intern from one of the top IITs. The 3rd year engineering student was articulate, but did now know anything about engineering or working with his hands. He just knew how to plug numbers into equations and solve them.

According to the latest statistics available, only 6-7% of India's engineering graduates are employable in core engineering sector and these interns clearly were part of the trend! Companies spend huge amount of money training them and this naturally translates in the increased cost of production of goods. It is really a sorry state of affairs regarding engineering education. We boast all the time that we have the largest pool of technical workforce but they lack knowledge and are incompetent.

However, I feel that it is not the students' fault but a corrupt and broken teaching system, which fleeces these students. There are few good teachers of engineering but

by and large most of them are mediocre (even in the IITs) and the stress is more on passing examinations rather than hands-on learning experience.

In the past we had many interns from good engineering colleges of Europe and U.S.A. Whenever a task was given to them they did diligently and only when they were stuck would come for discussion. On the other hand, the Indian engineering interns came asking silly questions at the drop of the hat since they are afraid to do work with their hands and did not know how to deal with situations where they had to think and act. This is the legacy of "passing exams" attitude.

In the last few years, I have given lectures and interacted with thousands of students not only in some of the major Institutes of India like IITs, NITs, management Institutes but also in schools and colleges in rural towns.

Everywhere I have found bright kids and students who want to do something meaningful with their life. Being better informed via electronic media like cell phones, internet and social networks they know what exists in the world and want to be a part of it. A proper guidance, inspiration and challenge at this stage by both teachers and parents will go a long way in producing better engineers and citizens of India.

The teaching in most of the engineering colleges including IITs has been deteriorating since last 20-30 years and is presently quite mediocre with most of the faculty not up to date in engineering research. In fact, IITs are consistently rated quite low in International University ratings.

Research and teaching go hand-in-hand because the excitement of new research is then passed on to the students. Most of the engineering colleges do not do any research and even in IITs, it is much below world standards hence the teachers are not able to inspire students to do it. The students therefore look for other challenges and are opting for non-engineering jobs like MBA, civil services and software oriented programs.

Four years of engineering education is a sufficiently long time to inspire the students to make a career in engineering. The fact that only a handful of students who pass out every year opt for engineering or research career shows that very little of good engineering is taught.

Most of the engineering colleges have adhoc teaching staff and fresh graduates become teachers. Even in IITs around 50% of faculty positions are vacant. The government (HRD ministry) in its wisdom thinks that by giving higher pay will help attract good faculty to these Institutes. This is a myth because great teachers are not attracted only by pay but by the scholarship environment of doing good research and teaching. Thus this is an egg and chicken story. Great engineering colleges world over produce good number of excellent researchers, some of whom also become great teachers. Numbers beget quality.

Also, some of the problems with engineering education have been created by Information Technology (IT) companies themselves. In the past these companies have heavily recruited from IITs and other good engineering college campuses. In fact not long ago there used to be a saying "anything that moves in IIT gets a job in Infosys"! This resulted in making most of the students complacent and bunk classes since they knew that they would be taken by IT companies irrespective of their grades. With this attitude it becomes very difficult for students to learn anything.

What needs to be done?
One of the ways forward is to create great research and scholarship environment in IITs and engineering colleges. This can happen when faculty and students work on problems of India and especially for rural areas. Providing basic necessities to 60% of our rural population is a huge technological challenge and R&D on this should come from good engineering colleges. At the same time emphasis should be laid on faculty spending time in industry. A linkage between faculty promotion and time spent in industry should be encouraged. This trend is prevalent in European and American Universities and needs to be emulated in India.

At the same time, the curriculum of engineering colleges and IITs needs to be modified so that emphasis put on hands-on work. Thus in four years of education

students should be made to do many functional projects. This will also help the students to develop interest in R&D. Engineering is a training of the mind and good engineers learn the methodology to apply analytical skills in problem solving. They can then apply this methodology in any field they choose to pursue.

Another way is for excellent engineers both in India and abroad to be invited to give lectures in engineering colleges. In addition, there are a good numbers of Indians who work as engineering faculty abroad in good schools and come on a yearly visit to India. HRD ministry should make provisions such that both the groups are encouraged to teach in engineering colleges at their convenience.

A good way for students to be involved in R&D is for them to spend one or two years doing work or internship in industries and in rural science and technology NGOs. If they can understand the real life problems then they can provide solutions to them.

Once the R&D bug gets into their head, it will automatically manifest itself in innovative solutions. This R&D bug should be put into these students even during their school days by following the US-based 'Maker Movement' (MM). The US had an old tradition of youngsters tinkering in their garages on amateur radios, making small household items, etc. Now with 3D printing technologies and hands-on training emphasis, US schools are now making students interested in creating designs, toys and new inventions. Once bitten by this bug, it is assumed that the students will be more involved in engineering by innovating and creating hardware-oriented products during their college days.

Together with emphasis on R&D, there is also a need to have social entrepreneurship and technical management as course streams in engineering curriculum. Social entrepreneurship should not only teach the students about the problems of rural India, but how to use solid engineering in solving them. Similarly, technical management course will help students learn about technology and innovation management. Both the technology management and social entrepreneurship streams should be grounded in excellent engineering education. The rise of great entrepreneurship all over the world has been mostly guided by technology managers

like [Willis Whitney of GE (with Irving Langmuir)](#), Steve Jobs of Apple, and Bill Gates of Microsoft, among others.

Finally, engineering education or any other education in the country will flourish if the bureaucratic control of Human Resources Development (HRD) ministry is reduced. Education is a creative process and it is dangerous to leave it in the hands of *babus* in HRD ministry.

For us to become a great and economically powerful nation and to give teeth to Government of India's slogan "Make in India", it is necessary that we create conditions to develop good engineers. In absence of such engineers who can create and innovate, we may end up copying innovations from abroad but even to copy a design we need good engineers!

The future of India belongs to the younger generation. All of us have to do our bit to get them involved in improving the lives of Indians. Unless we can provide basic amenities so that the rural poor can live a meaningful life, we will never become a great nation. This is a great challenge for all young engineers.

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