

Science Education: Some Reflections and Ways

Science education in India struggles due to lack of passion, ineffective teaching methods, and a system focused on rote learning, hindering innovation and progress in science and technology.

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Today, Science and Scientificity have become of paramount importance in every field of our lives. In the field of school and college education, we just give importance to science teaching. Scientificity is an entirely different matter. There is a lot of difference between Science and Scientificity; Science is about scientific knowledge, Scientificity refers to the state of being scientific in education, science and technology.

Science Education is mainly comprised of:

1. Science Learners
2. Science Teachers
3. Well-equipped laboratories and other infrastructures are needed for science teaching.

The question before us is how much importance we have given to science in the kind of environment in which we have grown up. Mostly, talented students in their Pre-University Examinations with reasonably good financial backgrounds opt for Engineering and Medical careers. As a result, the number of these students opting for the study of science is very small. Some students enroll in science courses with the

intention of getting jobs in some sectors. For example, after B.Sc. with Education degree, they may become High School teachers, and some after M.Sc. may become lecturers in colleges. Today, Science thus has become a way of livelihood. We have not made serious attempts to ensure evolving of a system to teach and learn Science in an exciting way. We are stuck with an environment which is not conducive to kindle curiosity and fire the imagination of students, which are necessary, among other factors, for making the learning of Science interesting and exciting.

Historically, if one looks back over nearly hundred years ago, some students learnt science extremely well. In fact, during that time there were very few teachers and High Schools were not as good as the present ones. In spite of all the constraints the country produced a first Nobel Laureate in Science (Physics) - Sir C.V. Raman in 1930. Afterwards, we have not seen a second Nobel Laureate in science in the last ninety years of our history. Similarly, it may be noted that those who went abroad after 1960 were selected based on their academic credentials. Later, there were special aptitude-testing examinations for the selection of students for studying abroad. It so happened that many who went abroad particularly to USA did not return to the country. There they found for themselves good jobs, positions, an ambience to excel and good life. Net result of this brain drain was that we lost talented scientists and the country was left with largely second rate scientists.

The kinds of high-tech based equipment we employ in scientific research are imported from abroad. Further, many people who were sent abroad for training by Govt. of India did not return either to exploit experience for enhancing the work nor build scientific pool of people. One may ask for answers from the basic question as to why all this happened. The simplest and the well thought answer one can give is that, in our system we have not given enough importance to Science Education which it deserves. Today, teachers do not get the respect in the society. They do not get enough salary and as a result they consider 'teaching' as a mere job' for livelihood. The net result is teachers have lost interest in knowing learning more about the subjects they teach. Further, my own experience is that when I told a teacher, who was teaching a subject for more than ten years continuously, to choose another subject in its place, his simple answer was -



"Sorry Sir. I cannot. It is not possible" Such teachers simply presented the same topic insipidly before the students, year after year, till they retired from job. This is the situation in many schools, colleges and universities in our country. In this context, let us look at an interesting and enlightening case from Caltech, one of the best American universities in the world. A physics professor, who was a Nobel Laureate too, was asked to teach students at the PU level (Feynman) during 1961-63. Initially, he said it was not possible for him as it was a full-time assignment involving a good deal of preparation. When persuaded by Caltech, he accepted and taught students for 3 years with commitment, dedication and preparation with full of insights, making it an interesting and exciting. It may be noted that during those three years he could not carry out his research work. Lectures were meant for enthusiastic students. The personality of the lecturer was so interesting that a large number of students (and some of his colleagues) used to attend the classes, filling the class room all the while. Many used to sit in the windows and on the floor of the hall. Two of the colleagues took down notes of his lectures (and also video recorded lectures). All of this culminated in a three volume set of books based on the lectures and were published under the title, "Feynman Lectures on Physics". The professor who accomplished this feat was Richard P. Feynman. The three books bear the name of Feynman, Leighton and Sands (the two were his colleagues who attended the lectures). The three books rank among the classics of our times. Some of those students who attended the lectures went on to become very fine scientists including winning Nobel Prizes. However, none of those students matched Feynman, the great teacher.

One important lesson we learn from Feynman's experiment is that teachers in the US, UK, and few other countries study deeply the subject they teach and enjoy the subject as well as teaching process. Unfortunately, this kind of situation does not prevail much in our country. Also, parents in our country, always, think whether their children get jobs paying higher salaries. Hardly, we teach Science in an exciting way so that students really learn Science. Also, few teachers who are capable of better teaching will not teach with interest and dedication. The reasons for all the mess in teaching-learning Science are the irregularities in the appointments of teachers. We need teachers who are competent and capable of studying the subjects themselves in depth,

which they teach. The monitoring mechanisms, as to how teachers teach and what they really teach, are very weak. Even these are not seriously implemented. Teachers Training Programs are organized but nobody bothers about the effectiveness of the programs. We do not have meaningful data about the percentage of teachers enhancing their competencies. We seem not to bother whether the training of teachers has made any impact on the learning of students and whether the trained teachers are attracting large number of students for the study of science. Another important issue which bothers is that students after completing their prescribed PU courses, whether they learn or not, join for tuition classes which prepares them for Entrance Examinations to get admissions in Engineering and Medical colleges. Getting ranks is the only aim through rote learning and not the learning leading to understanding of the subjects. As colleges do not allot courses to students as per their liking but based on the basis of marks students secure, students resort to malpractices to secure ranks. In this way Education has become a commercial commodity. People may ask then, how come we have done so well in the fields of Atomic Energy and Space Science & Technology. The answer for this lies in finding out whether concerned scientists and technologists had been abroad for training or were trained in India itself. This is important. For, those who go abroad have the opportunity of interacting with scientists in those countries. Similarly, if we say we are using second grade scientific equipments it means that we are modifying the technology got from developed countries and use for our requirements. All this, in no way means that we are not intelligent or competent. But at the same time we note that no important discoveries/inventions/innovations are taking place as we expect. If we say otherwise, then the question arises why there are no new Nobel Laureates in the field of Science and Technology. S. Chandrashekar the great astrophysicist got Nobel Prize when he went abroad and worked there. The other Nobel Prizes went to the persons of Indian origin who had settled abroad.

For those who are staying in India, as said earlier, job has become much more important. They do not feel the necessity of doing quality research and have no urge to strive for developing our own science and technology for our own needs. The root cause of this apathy lies in the fact that, in our Education System, the full control lies

with the Education Ministry, not with enlightened and educated citizens. Competent and qualified persons have not much freedom to accomplish things of value. It is interesting to note, in this context, Russia (earlier Union of Socialist Soviet Republic or USSR), during the reign of Joseph Stalin, had no contact communication with the external world. Iron curtain was drawn. Scientific achievements of USSR were not known to the outside world. When the iron curtain was lifted after nearly four years, four Nobel Prizes went to Russian scientists. When the reasons for these achievements were investigated, it was found that, though Russia was a Communist country, the scientists received higher salaries compared to others, even compared to some important officials. Top scientists were provided with two houses - one in their work place and the other one in the region where they could spend their holidays. Importantly, the scientists were respected. What this illustrates is that how one can attract and retain persons who are competent and interested in teaching and research. Until and unless this kind of strategy/policy is adopted we cannot progress in the field of science and technology and cannot emerge as a developed nation. We see that while many have become millionaires at the time of their retirement, the tragedy is that we are not realizing that development of the country will not take place with such people.

To understand the subtleties of developments of Science and Technology, we need to be well educated. For this to happen teachers who are motivated and interested in life-long learning be appointed. Teaching should be a passion for them. For example, while appointing teachers for high schools, we should not only consider their qualifications but also dedication and love for teaching profession. Most of us have heard the name of Michael Faraday. He did not go to any college. But his contributions as a scientist are amazing and invaluable. Royal Society of London honored him for his phenomenal research work. What Faraday's example illustrates is that advances in science and technology take place where scientists are valued for their merit/competence and quality contributions.

Education can be compared to nurturing the growth of a tree. It involves supplying right manure and watering properly. Most important of all is that the planted sapling should be disease free, that is to say, remain healthy. This is what is needed to happen



in our institutions of science. However, it appears to be a remote possibility as the educational institutions have already been bereft of the spirit of motivation, passion and dedication. We are in a situation of not knowing where to start and who has to improve whom. Further, if we look at the academic grades students secure at SSLC (10th class) and PUC (12th class) examinations, one gets the feeling that they must be geniuses. Instead, the reality is that students never read anything beyond books prescribed and many teachers never teach anything beyond the syllabus clearly marked. As a result of all this the Educational System has stagnated. It is a Herculean task to improve or reform it.

India is a big country with great heritage. Only way for the improvement of the Education System is that it requires a kind of revolution and countrymen be educated. We may give suggestions for achieving the overhaul of Education System; that's all. But implementation of suggestions/ recommendations lies with the politicians and our leaders. However, they do not have time to look into suggestions/ recommendations; they are occupied with other priorities. Let us look back in time. Kothari Commission (Education Commission) Report (1964-66) which reviewed the state of education at all levels and gave recommendations to educate India. It is a very good report but was not implemented completely. Since then few more committees' reports were submitted as sought by the Govt. Recently, the Central Govt. has brought forth yet another new National Educational Policy 2020 (NEP 2020) whose effective implementation appears to be very difficult. The reason is simple. To produce excellent graduates we need motivated students with good attitude and aptitude for learning, for which to achieve qualified, competent and inspiring teachers are required. Along with these two factors what we need is the healthy ambience in the society which promotes the first two.

In countries like the US, the UK and others, studies on how to enhance the quality and competence of students have been conducted. It is demonstrated that we can develop students, whom we call "second class" into 'first class' students. How can we achieve this kind of transformation in our country? Who has to change the "indifferent dull educational environment"? How it has to be done? Some will say, casually, we need to

do this in the existing social context. How is it possible? Because, while appointing teachers we have to take care of reservation and then qualifications. We never bother whether qualified teachers are competent or not and, whether they can get along with colleagues and work harmoniously in groups or not. We also do not bother about the salaries we pay. Most importantly, we never bother about searching for candidates who are better than the ones appointed.

Another strange situation exists in our system. We assign teachers all kinds of work not related to teaching. The work may concern census, elections, or Corona related works. They do not have sufficient time and freedom to do well their work of teaching. So, it becomes difficult to expect excellence in their teaching. When the system does not care for a person, the person also will ox pace for the system. This is the story of Education in our country. It has become very difficult to understand as to how to go about improving the Educational System. If enlightened persons with good character, integrity and educated in a true sense come together and discuss issues and convey the same to willing leaders and enlightened politicians who can listen and act, then only it is possible to rejuvenate our educational System.

References

This was the last talk delivered at Regional Science Center Dharwad in Kannada by Late Prof. M. I. Savadatti, Former Vice-Chancellor of Mangalore University. <https://www.youtube.com/watch?v=pBhtETOrhBM>

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