The title of this article comprises of two nouns, Education and Science. Let’s examine the two words before proceeding ahead.

Education in its general sense is a form of learning in which the knowledge, skills, values, beliefs and habits of a group of people are transferred from one generation to the next through storytelling, discussion, teaching, training, and or research. Education may also include informal transmission of such information from one human being to another.

Formal education occurs in a structured environment whose explicit purpose is teaching students. Usually formal education takes place in a school environment, with classrooms of multiple students learning together with a trained teacher.

Education is often presumed to be the ultimate panacea for all social problems. Education is a practice that has evolved for institutions to develop ‘useful’ human resources, from providing trained work force, to builders, communicators, philosophers. In my opinion, Education is the ability to listen to almost anything without losing your temper or your self-confidence.

Now, “Why do most students join a university/college? May be because:
1. They have nothing better to do at home.
2. They get to know from their friends and acquaintances or Hindi films that college is the cheapest club, where one meets future friends and future spouses.
3. Because their parents want to give them money and time to enjoy life for a few years till they are old enough to take up a job/business.
4. They have been told/taught that a university degree is useful to enhance one’s value be it in the matrimonial market or the job market!

Of the very few who join the university with a desire to gain knowledge, many are disadvantaged because of their school education, which is predominantly oriented towards rote learning and getting marks so that they may get admission to a reputed institute/college.

Can such students be interested in any learning in a classroom? Perhaps it may be possible, but only if the teacher is ready to take up an adventure and ready to tread an unfamiliar path. Because, the teacher is also a product of the same social system. The teacher would have to be prepared to teach unconventional courses far different from what s/he took as a student and prepared to participate in formulating a totally new course content.

Let us now consider the second noun in the title of this article – “Science”. Science has developed into one of the greatest and most influential fields of human knowledge. Different branches of science investigate almost everything that can be observed or detected. Science as a whole shapes our understanding of the universe, and ourselves, through observing various phenomena, developing concepts to explain them and finding relationships between various concepts.

It has developed into a mammoth body of knowledge/information through objective analysis. It grows as time goes by, building on work performed earlier. In all fields of science, old or new, ‘scientists’ use the same systematic approach, known as the scientific method, to add to what is known.

During scientific investigations, scientists put together and compare new discoveries and existing knowledge. In most cases, new discoveries extend what is currently accepted, providing further evidence that existing ideas are correct.
A ‘scientist’ is a person who is aware of the many phenomena that occur in nature. S/he also understands the various concepts that are used to explain natural phenomena. S/he is engaged to make observations and find if the existing concepts are adequate to explain them. Most people believe that any person with a university degree in science can be called a scientist.

But, strictly speaking, a scientist is a person who is curious to know the answers to questions, knows what answer are fit to be called scientific; for doing so s/he may need to carry out experiments, the results of experiments may warrant him to put forward a hypothesis, which may require discussions with other scientists or publishing papers in science journals. A scientist is a person who is aware of the many phenomena that occur in nature. S/he also understands the various concepts that are used to explain natural phenomena. S/he makes observations and tries to find if the existing concepts are adequate to explain them.

A person who has earned a university degree in science can be expected to have a fair amount of knowledge about the existing concepts, laws, hypothesis or theories that have been put forward by scientists past and present. But does that really qualify such people to be called scientists? A true scientist is one who tries to add to this knowledge and not just earn a living using this knowledge.

Science has grown into an intricate mammoth structure of information. The focus of the common curricula in the majority of science courses is to accommodate most of the modern concepts and methods. It is almost like an ancient language, say Sanskrit or Latin. For example, no science course is thought to be complete unless it includes concepts like orbitals, wave functions, hysteresis, genome, etc. I wonder how many students really understand these concepts.

During the interactive round of a competition called ‘Science Quest’ for undergraduate students of University of Delhi, organized by the Center for Science Education and Communication, a student, in response to a question, asserted that one can experimentally observe the motion of orbitals in a molecule. When asked who told her that, pat came the reply, ‘Our teacher!’ In fact most of the questions posed by the various student teams and responses to them were of that nature. Obviously, neither the students nor their teachers are comfortable while comprehending these concepts.

So, are all such concepts totally essential for science? Can’t we enact alternate structures of concepts and processes that are useful for day-to-day life? Will not these structures qualify for the term ‘science’? Science has become too huge and complex an edifice to be easily comprehended by an average student or teacher.

It is a structure of knowledge that does not use concepts like quantum, hybridization of orbitals, etc. The various subjects like biology, geology are in fact sciences as much as physics and chemistry. There have been various alternate curricula of science developed just like Nuffield science (UK) or Salter’s science (UK). There is a need to develop alternate science curriculum that is specifically suited to the Indian society.

Talking about teachers and teaching, in an article in the science magazine Resonance, Prof P. Balram, former director of the Indian Institute of Science (IISc, Benagluru), says:

“The early undergraduate classes are almost an extension of high school; although college brings with it a sudden loosening of the constraints that sometimes seem so restrictive for teenagers on the verge of a transition.

Teaching is traditionally a term reserved for those who lecture, explain and inform in the confines of a classroom. For teachers, the blackboard and chalk are their traditional instruments; their only other requirement was a sheaf of well-thumbed notes or a prodigious memory, from which facts could be recalled at will. Times have changed in institutions of higher education, where visual aids and computers have invaded classrooms. ‘PowerPoint’ allows instructors to project in rapid fashion reams of information, while the Internet provides an inexhaustible and valuable resource, after class, if used wisely. In the electronic age even teachers may need
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to change, as they move into a position where they must guide students to learn. In schools little has changed...

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At all levels, from school to the university, there is a growing shortage of trained, committed and enthusiastic teachers. The dramatic expansion of the higher education system, especially in the areas of science and engineering, has suddenly highlighted the great demand for faculty. It has been easy to create IISERs and IITs by decree; it appears harder to recruit faculty who will be both researchers and teachers. As the demand for increasing India’s scientific productivity grows, so too will the demand for scientists in national laboratories where there is no teaching...

In my opinion the problem is not with ‘principles’ but rather with the curriculum. Inherent in this declaration is the assumption that there are no principles for developing a curriculum. In the dialogue of education, my agenda is to dispel the notion that there are certain time-honoured, proven rules capable of guiding us when we want to prepare a curriculum for children’s education.

The position I wish to support is the opposite one – that there is no escape from reflecting on the conditions obtaining in our society and culture if we want to give worthwhile education to our children. The problem of curriculum is related to our perception of what kind of society and people we are, and to our vision of the kind of society we want to be. By taking shelter in the ‘received’ perspective and the ‘principles of curriculum development’ that it offers, we merely shun our responsibility and allow ourselves to be governed by choices made long ago or elsewhere under very different circumstances."

What can heal this injured paradigm of science education? Science presupposes experimentation and experimentation presupposes some laboratory facility. The few stories about scientists and their discoveries students come across in science textbooks, invariably belonged to affluent families that could afford a laboratory to experiment, which is invariably not viable for most students studying science in an Indian educational institution. As a result experimentation is most often ignored.

There is a need for a judicious choice for the curriculum, because most often the student has no choice and really little knowledge for the basis of the choice. One often chooses a particular curriculum when one enters a university on the basis of popular perception of the utility (career opportunities after successful completion) of the course. The utility of many abstract concepts now in the science curriculum, for an average student, goes not beyond the fact that it helps in cracking some competitive examinations, which if one clears, can lead to a ‘successful’ career and hence a happier after life.

Life, death, information, love, money, aspirations, success, happiness, governance, corruption are no less abstract concepts. These are concepts that puzzle the common young mind nowadays. Wouldn’t it be more profitable if a part of the time science students/teachers invest while being in the university is spent on learning more about abstract concepts in place of some of the conventional and rather outdated concepts of science that constitute the science curriculum nowadays?

It is not really impossible, as we, some members of the Centre for Science Education and Communication (CSEC) along with some school science teachers attempted a few years ago, while we authored science text books (entitled Do and Discover, Karen aur Khojen) for school students at the middle level for SCERT (Delhi).

No curriculum can fit the needs and temperament of all students/teachers at a particular time. So, there would always be a number of students who would find abstract concepts in the science curriculum more appealing. Perhaps they would make our future ‘scientists’!

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