School Level Science Education System and Status in India

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In India, the entire schooling span is divided into multiple stages beginning with nursery or pre-schooling (at home, kindergarten or crèches, age group 3 to 5), followed by primary (class I to IV, age 6 to 10) and secondary level formal education (class V to X, age 11 to 16) and finally ending at the higher secondary stage (class XI-XII, age 17 to 18). Science education covering natural sciences commences on at the secondary level (class V) though counting numbers and arithmetic is a part of the primary level training itself. While curriculum is common without specialized subjects until class X, students select specific streams (science, humanities, commerce or vocational courses like pharmacy) only at the higher secondary level (class XI-XII). Promotion to the next class is usually administered through an annual examination conducted by the school itself, the public examinations at class X and class XII provide exit/completion options and are conducted by the respective Boards of the state or central government level.

Education, as per the Constitution of India (article 45), is a common subject between the State and Union Government. As a result, while each state has its own School Board both at the Secondary and Higher Secondary level, a country wide network of schools with a common curriculum and rules exist under the Central Board of Secondary Education (CBSE), which administering the two major nation-wide public examinations called All India Secondary School Examination (AISSE) and All India Senior School Certificate Examination (AISSCE). For both these examinations, National Council of Educational Research and Training (NCERT) is the apex body for curriculum related matters including designing and printing of text books. Besides CBSE, the Council of Indian School Certificate Examination (CISCE) offers Anglo-Indian pattern of school education in India and conducts three examinations at class X and XII, namely, Indian Certificate of Secondary Education (ICSE), Indian School Certificate (ISC) and Certificate in Vocational Education (CVE, Class/Grade 12). As an alternative path, the country offers the scope of accredited school level education through the National Open School or the National Institute of Open Schooling (established by the Government of India in 1989) by distant education mode and also, the International Schools, accredited to curriculum of certain international board or standard (e.g. International Baccalaureate Program and/or Cambridge International Examinations). The National Institute of Open Schooling (NIOS) conducts two examinations, namely, Secondary Examination and Senior Secondary Examination (All India) and also offers courses in Vocational Education. A large section of Muslim population prefers religious education administered at Islamic Madrasah schools, which are controlled by local state governments or autonomous bodies like Darul Uloom Deoband.

According to the Constitution of India, elementary education (age group 6-14) is a fundamental right of children. India has about 688,000 primary schools and 110,000 secondary schools. The government has rolled out many plans to implement

elementary education universally through schemes such as Sarva Siksha Abhiyan (SSA), District Primary Education Program (DPEP), Operation Blackboard, Mid Day Meal, etc. As per the definition of Census of India (2011) that an individual above 7 years of age who can read and write in any language can be considered literate, the National Literacy Rate is about 74% (82% among men and 65% among women with the state of Kerala registering the highest (93%) and Bihar the least (64%) level of literacy).

Though the enrollment rate at the secondary (up to class X) and higher secondary (class XI-XII) level is 52% and 28%, there is an alarming level of drop out (~ 48% of enrolled students) rate in elementary education stage. The record of in-service training in India is certainly not encouraging: only 10% of manufacturers in India offer such training to their employees, compared to over 90% in China.

India is land of immense diversity in terms of land and geography, history of civilization, anthropological and ethnic background, population density, culture, cuisine, language, religion, weather/climate, economic status, political inclination, and above all, level of education and enlightenment. In the words of Tagore (Nobel laureate 1911): India is a melting pot of humanity. A country with 2nd largest population (1.22 billion) in the world living on about 2.5% of the earth's total surface area, ranking 10th in terms of nominal GDP (~ $ 1.8 trillion) and credited to be one of the oldest known civilization dating over 5000 years from now, on one hand, India can boast of being the 11th nuclear state and satellite launching capable nation, but on the other hand, is burdened with ignominious reality of having over 300 million illiterate and undernourished population, high maternal and child mortality rate, and per capita income of only about $100. However, it is also undeniable that India, despite its diversity and problems, is blessed with a rather young population (average age is 29 with 65% population below 35 years of age) and is fast improving in several human indices like life expectancy (now ~ 65 years), literacy rate (now ~ 74%) and elementary education enrollment level.

India is now making bold strides for educating the masses. Education is now free for children between 6 to 14 years of age with provisions for free midday meal, budget allocation for education during FY 2013-14 is INR 65,865 crore (~ $ 650 billion) of which nearly half is for Sarva Shiksha Abhiyan (SSA) or 'education for all' scheme. The Government is committed to raise the plan outlay on education to 6.5% of GDP and 20% of total budget.

With regard to initiatives on **S**cience **T**echnology **E**ngineering and **M**athematics (STEM) in India, the proactive measures initiated in the recent past are:
- Innovation in Science Pursuit for Inspired Research (INSPIRE) program sponsored and managed by the Department of Science & Technology for attracting young talent to the excitements of a creative pursuit of science as a career option and building the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base in the country. INSPIRE Scheme includes three components: (a) Scheme for Early Attraction of Talents for Science (SEATS), (b) Scholarship for Higher Education (SHE) and (c) Assured Opportunity for Research Careers (AORC). The target is to enroll 0.2 million school children in

the age group of 10 to 15 years, offer INR 5000 per child as scholarship and spread the awardees country wide (at least two students per secondary school during the next five years).

- Kishore Vaigyanik Protsahan Yojana (KVPY) is an on-going National Program of Fellowships in Basic Sciences, initiated and funded by the Department of Science and Technology, Government of India, to attract exceptionally and highly motivated students for pursuing basic science courses and research career in science.
- Homi Bhabha Centre for Science Education has been made the country's nodal centre for Olympiad programs in mathematics and sciences. The programs aim at promoting excellence in science and mathematics among pre-university students.

It is pertinent to point out that school education system in India, though is placing increasing emphasis on the two end-subjects of the philosophy acronymed STEM, neither engineering nor technology is a part of regular curriculum of pedagogy in India. Notwithstanding the marginal scopes of vocation training through work education scheme, not much time or effort is spent on exposure to engineering or technology during secondary or higher secondary schooling. Of course a section of students may and do opt for diploma or certificate level trade training after class X or XII level public examination, and even choose technical streams like pharmacy or engineering as a specialization stream during Higher Secondary (class XI-XII), regular curriculum during class I to XII does not include special/dedicated courses for educating pupils in basics of engineering or technology.

Yet engineering is one of the most sought after discipline in tertiary level of education. This year nearly a million enrolled for graduate engineering courses in various disciplines across the country and 0.5 to 0.7 million actually end the course and come out as graduate engineers every year. While the output number is encouraging, maintaining uniformity and quality is a major concern. The quality is significantly different between the curriculum, level of teaching and research, funding and infrastructure existing in Indian Institutes of Technology (IITs), who are comparable to the best engineering schools in the world, and several newly established private institutions of dubious credentials offering engineering degrees with neither dependable pedigree nor appropriate structure. The issue gets more complicated due to the affirmative law and action of the country in terms of reservation in admission and employment based on caste or social/historical background lineage. Other major factors responsible for deterioration of standard of technical education are: (a) inadequate infrastructure, (b) poor quality of teaching staff, (c) lack of proper collaboration and exposure to industry, (d) unavailability of standard text and reference books and materials, and above all, (e) general economic condition in the society. The national regulatory body, All India Council of Technical Education (AICTE) is aware and committed to ensure acceptable standard in due course. Indian National Academy of Engineering (INAE) as the sole peer body on engineering in the country must assume a proactive and decisive role in that matter. INAE role assumes greater importance in the wake of Indian Government's resolution to infuse significantly larger investment to enhance the quality of STEM education in K-12 (class I to XII) level in India and realize the dream of making India a technological superpower, sooner than later.