Technical education – Vision 2010*

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Preamble

From time immemorial, education stands broadly for development – development of mind so that it can liberate itself from ignorance of what we are, what nature is and how we interact with nature. Very appropriately, a Vedic quotation describes the goal of education as *Sa vidya ya vimuktaye* – liberation through education. The goal of education has not changed but the gravity and multidimensionality of the goal is becoming starkly clear to all thinking human beings. With increasing demands of civilized societies whose membership continues to grow unabated, the goal of education has become associated with a goal of achieving 'good living' for the individual as also the society which pays for the education. And, thus, education gradually has assumed a purpose in the form of a social contract for the educated to serve the society.

Education for manpower development

The ability to solve the great challenges to the future depends crucially on a society which is skilled and scientifically literate. People all over the world want change. Revival for survival has spurred everybody. To meet the essential requirement of the vast population today, we need to make full and judicious use of the technological advances that have taken place. It is no more a question only of dealing with a rapidly advancing technology. It is also and even more important a question of our involvement in advancing technology rapidly enough to meet the challenge fulfilling societal needs. The role of technical education in manpower development for such a new world is thus self-evident.

Education is the most vital resource for economic development. Human resource development has a multiplier effect on utilization of all other resources. It is said that it is not the poverty of natural resources but rather the poverty of human resources which is responsible for the sad state of affairs of underdeveloped countries.

Education – technology synergism

The industrial revolution followed by a technological revolution all over the world have changed our total concept of education. Born out of necessity is the concept of technical education which goes beyond liberation of the mind of the seeker of this knowledge or the society to which the seeker belongs and to which he/she has a social contract. The new horizons are national prosperity through application of technical knowledge. This vision is best summarized in perhaps the most comprehensive and stimulating document (*The 1958 Scientific Policy Resolution of India*) ever published officially by any country in the world. It states: 'The key to national property, apart from the spirit of the people, lies, in the modern age, in the effective combination of three factors, technology, raw material and capital, of which the first is perhaps the most important... But, technology can grow out of the study of science and its applications.' This major industry paradigm shift has been dictated by the realization that science and technology have transformed numerous societies and nations into economically prosperous ones during the 19th and 20th centuries.

To appreciate the concern of our planners spearheaded by our first prime minister, Jawaharlal Nehru, the objectives of the 1958 Scientific Policy Resolution are listed below:

(i) To foster, promote and sustain, by appropriate means, the cultivation of science, and scientific research in all its aspects, pure or applied and education;
(ii) To ensure an adequate supply within the country, of research scientists of the highest quality, and to recognize their work as an important component of the strength of the nation;
(iii) To encourage, and initiate, with all possible speed programmes for the training of scientific and technical personnel on a scale adequate to fulfil the country's needs in science and education, agriculture and industry and defense;
(iv) To ensure that the creative talent of men and women is encouraged and finds full scope in scientific activity;
(v) To encourage individual initiative for the acquisition and dissemination of knowledge and for the discovery of new knowledge, in an atmosphere of academic freedom, and
(vi) In general, to secure for the people of the country all the benefits that can accrue from the acquisition and application of scientific knowledge.

The decades of eighties and nineties have witnessed phenomenal developments in the global social and political scenario, natural science, engineering and technology and industrial production. New frontiers of science have given birth to new technological revolutions such as silicon chip, computer, communication, information/knowledge, molecular electronics and biotechnology. Major world economies are increasingly being driven by 'knowledge industries'. Globalization of economies, technologies, and prevalence of competitive market forces are dominating the financial health of the new world. This has led to a new world trade organization (WTO) regulated by a General Agreement on Trade and Tariff (GATT). If these agreements become accepted world trade order, it is the economics rather than political philosophies and military powers which will rule the world. The world economies, in turn, will be determined by the generation and utilization of scientific knowledge for industrial production. Consequently, the synergetic relation-

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ship between technical education and the development of science and technology is undergoing dramatic and dynamic changes all over the world. Of course, planners in our country are quick to respond in the form of yet another document – the *Technology Policy Statement of 1983*.

It is clear from the two documents quoted above that we are capable of defining a serious problem in the best of sermons of biblical value. Indeed, we have gone even beyond by setting up a variety of committees and commissions to examine our education policies. Such commissions as those led by our distinguished educationists such as Radhakrishan, Kothari, Thacker and Nayudamma have produced great documents of historical importance. *The New Education Policy of 1986* is the most recent voluminous document. And, the Rama Rao Committee is presently searching for new material for a new document. Has technical education or technology development benefitted from these expensive and time-consuming exercises? Why do we continue to face large-scale poverty, unemployment, illiteracy, malnutrition, disease, and a struggling economy? Regrettably, our education in general, and technical education in particular, continue to lose relevance to the needs of our society and nation. Even the best of our technical institutions in the country are barely able to keep above the level of mediocrity. We must remember that only excellence can breed excellence. And to achieve any semblance of excellence in our technical institutions, we must initiate major structural, management, financial and academic reforms.

We need to have a vision for the next century. And we must have a national commitment, industry involvement and political will to overhaul drastically our technical education system. What reforms should we contemplate? Here are some suggestions:

Proposed reforms

1. Antiquated, passive teaching must give way to active participation of students who should be respected as adults. Thus, an old-fashioned conservative attitude of parent–child relationship should be replaced with adult–adult interactive relationship.
2. We must incorporate flexibility in our curriculum through modular and bridging courses. Taking appropriate modules together to earn a degree should be as much a responsibility of the taught as that of the teacher. Students must be allowed to exercise their judgment on what they want to learn and at what pace. As long as students pay for their education, restriction on their pace and the period required for completing a degree must be minimized as far as possible. In some ways and in some cases a 'cafeteria' style for 'pick and choose' would be desirable. The concept of a broad-based engineering degree (e.g. basic engineering) without any particular specialization should be experimented within selected institutions for selected candidates.
3. If technical education is to achieve employability, redeployment, skill acquisition, and attitudinal changes, multidisciplinary and interdisciplinary courses cutting across departments/centres must be encouraged.
4. Four-year duration for a B Tech/B E degree and 1.5 years for M Tech is not adequate for providing education of globally benchmarked standards. Flexibility through modular courses should take care of the problem. Work experience between semesters with flexibility of taking breaks should be an accepted policy. Facilities for part-time registration of students should be provided.
5. Both the undergraduate and postgraduate education must insist on a substantial experimental or technological project based on realistic if not real-live industrial problems.
6. Conventional laboratory experiments be replaced, at least partially, with challenging group projects aimed at fabricating devices/instruments/products. National laboratories (e.g. CSIR, DRDO, ICAR) and industrial R&D institutions should be given due status, recognition and incentives for getting involved in the laboratory training programmes. Such programmes must carry a lot of weight/credit towards a degree.
7. Integrated M Tech/M S degree courses, particularly in multidisciplinary areas like materials, energy, instrumentation, building technology, biotechnology, engineering physics, industrial chemistry, geotechnology, cryogenics and food engineering should be introduced. As an incentive for bright students to undertake higher studies, the dual-degree concept allowing two B Tech or one B Tech and one M Tech degrees in the same or related areas should be allowed.
8. All students of technical education must be exposed to such new courses as life science and life science-based technologies, reliability and quality and intellectual property rights, ethics, technology management entrepreneurship, etc.
9. Science based know-why engineering education must be supplemented with know-how technical aspects. Design and manufacturing courses must receive due recognition.
10. New pedagogical tools should be employed to impart multifunctional skills, quality consciousness, team and group spirit, healthy attitude towards innovation, etc. Our education must inculcate 'technology patriotism' in our students.
11. Institutions must have simple internal mechanisms to drop some courses and adopt new ones. Excellence demands rapidly changing and responsive system of education. A good institution should innovate unconventional courses and popularize them among students. A suggested list of such courses is: Agro-based technologies (aquaculture, horticulture floriculture, post-harvest processing), technology assessment and forecasting, biotechnology, energy and environment management, green technologies, natural products, nanotechnologies, composite materials, value-added minerals, patent laws, total quality management, human resource management, project management, culture and tourism and entertainment industries, etc.
12. Excellence cannot be achieved without highly motivated trained, active and professionally compe-

tent teachers. Introduction of M Tech and Ph D courses for Technical Teacher Training programmes must be introduced in selected institutions.

13. All teachers in technical education must be required to be involved 50% of the time in industrially oriented R&D, consultancy, entrepreneurship, or book writing projects. Industrial exposure of at least one year must be made mandatory for teachers.
14. A dynamic faculty in a technical institution must be allowed to serve private/public industries in technical or managerial capacities concurrently with teaching on time-sharing basis. Both students and faculty should be allowed to earn consultancy fees without any upper financial limits as long as the professional assignments do not suffer. Establishment of Science & Technology Enterpreneurship Parks and setting up of enterprises by the faculty as role models should be allowed by educational institutions.
15. Free or highly subsidized education is not conducive to generating excellence through curiosity, initiative, innovativeness and competitiveness. Students must be given flexible opportunities to earn while they learn and learn while they earn. In the matter of consultancy and IPR, students should be recognized as legal partners.
16. Through the availability of information highways, on-line distance education, and virtual campus (of national institutes), cross registration for courses by interested students and recognition and transfer of credits earned through such electronic media should be an accepted mode of technical education.
17. That we have the third/fourth largest technical manpower in the world is a misleading statement. Actually, our number of technical persons relative to our population is somewhere 25 to 50 times smaller than that obtained in various developed countries. Educating larger number of students in a population edging towards a billion mark calls for high-tech solutions through information technology which is changing the mode of delivery of technical education dramatically. The open university and distance learning systems using communication satellites, wired and networked computers and multimedia facilities, cyber space and cellular telephones provide a new and powerful interactive medium for education of masses. A state-of-the-art national educational information network (such as ERNET) with large bandwidth and several Mbps speed based on ATM switches at a discounted tariff are absolutely essential to provide on-line distance education, and shared electronic libraries/databases on a country-wide basis.
18. The need for updating the knowledge and retraining of technical manpower from time to time to cope with the rapid development in technology is urgently felt. Therefore, technical educational institutions must devise continuing education packages for specific requirements. Indeed, this informal and non-formal mode of education must receive immediate attention and recognition through a formal certificate/diploma/degree.
19. Excellence in technical education must be certified by peers and autonomous agencies of high credibility. Accreditation by any agency (such as UGC and AICTE) established by any Government cannot be taken seriously. Our National Academies and Industrial Organizations are well equipped to do credible job on payment basis. We must have periodically generated ratings for individual departments as also institutions. Such accreditation must have global benchmarking so that we can compete in the very lucrative international 'education industry'. Knowledge is a saleable and marketable commodity to-day. Education is a very respectable business. Countries such as USA and Australia earn billions of dollars by selling education worldwide. Our technical education must be good enough to attract higher calibre foreign students from advanced countries. We must internationalize technical education not for money alone but more importantly for international benchmarking and accreditation.
20. Technical education needs to be managed professionally in a business-like manner. Both Central and State Governments must be persuaded to leave the governance of the technical institutions to the professionals. Their major role should be to facilitate than to govern such institutions. The best government is the one which governs the least. Clearly, a new governing structure having eminent persons who are actually involved in education and employment of the technical manpower is needed. Employers must have a direct stake in running such institutions.

Concluding remarks

What we do not need is further new committees or commissions to examine the status of technical education in India. We hardly need to be told what is wrong with it or what is required to gear up to become globally competitive. What we need are actions so that we can participate in the sweeping knowledge revolution. My vision sees an integrated system approach towards manpower development. I see manpower development through education which will relate itself to the economic development of the country and as an instrument of transformation for participating in the knowledge revolution.

The future belongs to us with an urgency seldom felt before – times are afire with the urge to blaze new trails towards putting knowledge into fruitful motion. With the economy geared to new challenges and opportunities, the nation is poised to take giant strides towards globalizing our economy and bringing prosperity to the society. It is 'now or never' for educationists, scientists, engineers and technologies to help achieve an industrial resurgence with a patriotic zeal for the India of the year 2010 AD and beyond. The primary key to progress lies in our technical education with excellence and relevance which will help us not only to tackle our basic problems but also earn India an honourable place in the company of front-ranking nations of the world. Let us set ourselves time-bound targets and

work together confidently towards fulfilling them. Let us rededicate ourselves to the pursuit and attainment of excellence in technical education inspired by a sense of mission.

Let me conclude by a very appropriate quotation from a verse from *Gitanjali* of Rabindranath Tagore:

Where the mind is without fear and the head is held high;
Where knowledge is free;
Where the world has not been broken up into fragments by narrow domestic walls;
Where words come out from the depth of truth;
Where tireless striving stretches its arms towards perfection;
Where the clear stream or reason has not lost its way into the dreary desert sand of dead habit;
Where the mind is led forward by thee into ever-widening thought and action-
Into that heaven of freedom, my Father, let my country awake.

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Are we losing our heritage?

P. V. Sreekumar

Fragile ecosystems, aborigines and their traditional knowledge of the flora and fauna are apparently on the verge of extinction. The unique heritage on the lifescape of these pristine islands needs to be conserved.

Since the age of Darwin and Vavilov, the oceanic islands have been popular for their rich and diverse biological heritage. These strips of land masses isolated by vast expanses of blue waters quite distant from any biotic interference, proximal to adaptive radiation and optimum downpour were found congenial for organic diversity, endemism, evolution and speciation, they thus had biogeographical significance. Andaman and Nicobar archipelago with over 572 pristine islands, islets and coral reefs tells a similar story in a contrasting evergreen colour over the 'then turquoise blue' Bay of Bengal. Are these ideal heritage sites now intact, or are they under threat of extinction?

Stretching to a land mass of about 8293 sq. km, with a green cover of over 86% of it, and a coast line of 1962 km, this chain of islands runs almost parallel to Malay peninsula and shows marked affinities to that as well as to Burma, Malaya and Indonesia in its analogous elements of biodiversity. These tiny islands, possessing a warm-humid climate with an average rainfall of over 3800 mm, apparently look like rugged terrain, consisting mostly of undulating hillocks just emerged or lifted out of deep sea, the highest point being the Saddle peak of the North Andaman with an altitude of only 732 m. Saldanha[1] speaks of the hypothesis behind these emergent peaks being submerged mountains related to the Arakan Yoma Range of Burma. The fragile ecosystems of these islands could be categorized into the forest, the marine and the mangrove.

Despite many exhaustive surveys to explore the rich biological resources of these islands, a comprehensive knowledge of their traditional wealth and genetic resources is ironically still lacking or yet to be catalogued. Out of the probable 2500 species of flowering plants occurring here, about 11% are endemic to this archipelago and another 11% are economically important or otherwise useful to mankind[2]. A recent census lists over 150 species of wild relatives of crop plants. Over 100 ornamental plants grow wild which could be domesticated and interpreted for further crop improvement as well as for aesthetic beautification programmes. On these tiny islands are found over 250 medicinal plants, 110 species of orchids[3] and over 75 species of wild edible fruits. Moreover these islands have over 110 species of grasses, 80 kinds of underutilized vegetables, 50 species of

Nicobarese of Trinkat island construct their huts in a traditional way – Are we not losing this heritage now?