VITAL CONCERNS IN CURRICULUM DEVELOPMENT IN SCIENCE AND MATHEMATICS

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During the past three decades or so, India has been struggling hard to achieve universalisation of elementary education. While considerable progress has been achieved in terms of creating an infrastructure, that is, in terms of providing a school within walking distance and in terms of ensuring that there is at least one teacher available per school, the target of achieving universalisation has been eluding us all the time. The aims of achieving 100 per cent literacy, of ensuring 100 per cent enrolment in Class I, and of retaining all the enrolled pupils for at least four or five years, all seem hopelessly beyond realisation.

At this juncture when we are passionately discussing the new policy on education, and when for the first time in our history we have acquired powerful technologies like satellite communication and home computers, it would be very relevant and meaningful to discuss the new concerns in curriculum development in science and mathematics, in terms of the explicitly declared national goals and objectives. The brief note aims at listing some of these concerns with the hope that these will be reflected in curriculum development.

Equality of Educational Opportunity

While the question of physical access seems to have been solved, we are far from achieving equality of educational opportunity in its true sense. The classroom proceedings, instruction and instructional materials, the system of examination, and the school timings, hardly take note of the changing pupil profile. The first generation learner, unable to make progress in this strange inhospitable place called 'school', soon drops out. The first task of the primary school is to realise the fact that the first generation learners are not as "ready for school" as the traditional learners, and need a pedagogy for overcoming this hurdle. While considerable lip service has been paid to this problem, little has been done to change the curriculum in teacher training institutions to make the teachers aware of this specific problem. Even field tested methodologies developed by groups like the Kishor Bharati in Madhya Pradesh and the Homi Bhabha Centre for Science Education in Maharashtra, are not considered for incorporating in syllabi for colleges of education.

Research findings are applauded and promptly shelved. Something has to be done to change this if the concept of equality has to go beyond 'throwing the gates open' and lead to the establishing of equity.

Improving Rural Schools

The quality of education available to the common man will depend upon the quality of typical schools catering to the vast majority of our population. Rural schools as well as schools in metropolitan areas catering to the weaker sections of the society continue to be poor. Almost the entire grant available to these schools is consumed by teachers' salaries, leaving little for laboratories, equipment, consumables, etc. A policy directive changing the grant-in-aid pattern must be issued and implemented on a priority basis. Otherwise we will continue to provide excellent education to the elites whose children will make full use of facilities in rich schools, enter institutions of higher learning, etc., while the rest of the population is at best fed with poor education.

Contents of the Compulsory Package

'Science for all' is yet another slogan that needs to be studied carefully. If science (and mathematics) is to be made a compulsory subject, what is the content of science which every citizen must have? Unlike in developed countries where children are 'humoured' in school up to the age of 18, and are exposed to a large number of gadgets in a technology-oriented environment, school drop-outs in India occur fairly early. These drop-outs are not only not exposed to any technology; they are also denied an opportunity to get exposed to useful language behaviour which would enable them to undertake learning at a later stage. Science is expected to provide the individual with latest information regarding environment, properties of materials, new processes, etc., besides giving tools for (a) further learning, (b) manipulating the environment, (c) entering and continuing in a technical profession, and (d) coping with continuously changing and ever advancing technical world. In other words, science is expected to give the individual a new kind of literacy enabling him/her to function in an environment dominated by S&T, and to offer some insurance against being taken for a ride. I do not think we have identified such a package. Our curriculum for the primary school continues to be based on a pipeline approach (preparing students for the secondary school), ignoring the harsh reality that primary education is 'primary' for very few, and is terminal for most.

The Non-formal Stream

It is recognised that formal education may not reach everyone and that alternatives like the non-formal stream must be considered for achieving the target of universalisation. However, non-formal education as it is practiced today lacks organisation, and is an alternative to total absence of any education. It is an alternative to zero and not to formal education. Firstly, it aims at (and stops there) giving literacy in the sense of encoding and decoding letters, but does not ensure that students acquire reading comprehension. Secondly, it takes students only as far as common sense would take them, and does not introduce them to the faculty of critical

and abstract thinking. Considerable R&D needs to be undertaken if one wants to develop a pedagogy for imparting these skills in the non-formal mode. It is a pity that this aspect is being totally ignored.

Vocationalisation

The importance of introducing a vocational stream capable of catering to the bulk of our population has been mentioned repeatedly. However, one must realise that vocational education is expensive; it requires considerable resources to establish a vocational institute. Also, the recurring costs are higher than those involved in non-vocational institutes. It is difficult to see budgetary provisions made on a realistic basis, either in state budgets or in our national budget. Vocationalisation will not occur; we will have to pay for it.

There is yet another factor which is very important. Vocationalisation must be distinguished from professional education like engineering and medicine leading to a degree (and to a lucratice career). Students are unlikely to opt for a vocational stream if this option means burning their boats and losing all chances to enter the university or the professional stream. In that case the steaming would imply 'vocationalisation for the poor, and professional education for the elite'. The two models of streaming, one for India and the other practiced in Korea, are worth studying in this context. The consequences of these two models are obvious.

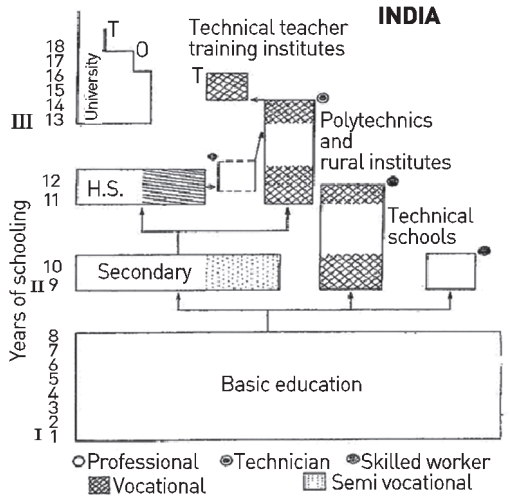

Fig. 1

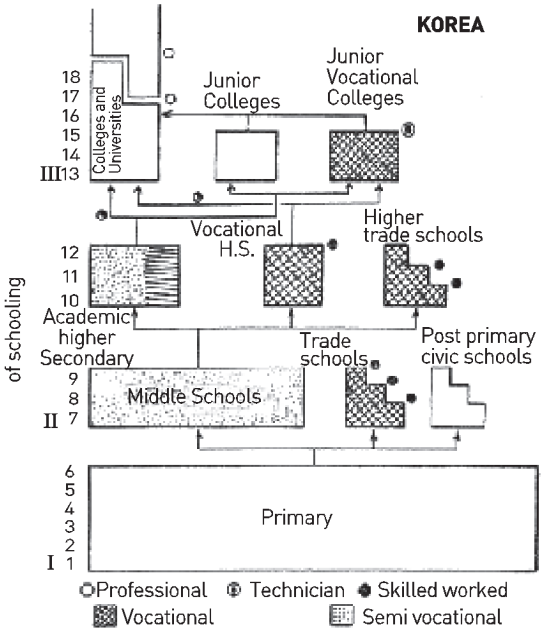

Fig. 2

New Technologies

New technologies like the satellite communication and the home computer are now available in India. Considerable progress is yet to be achieved in terms for providing an effective E-TV network while computers have just arrived. However, there is an aspect of national policy involved in the utilisation of these technologies. How do we perceive the role of the new technology? Are we, as a nation, committed to use these to overcome differences arising out of unfortunate socio-economic-cultural disparities, and to bring about democratisation of education in the true sense? Such a commitment has two major implications:

(a) The average (typical) school and the school in rural or inaccessible areas must get precedence over the elite school in getting the facilities installed. This is not easy. By definition, maintenance facilities are not available where the technology is needed most urgently. A systems approach involving the entire community will have to be adopted to reach the typical school, to install and maintain the equipment, and to train the potential users to derive the maximum benefit from these facilities. In the absence of such a commitment, the facilities will go to those who can afford them, with the predictable result of widening the gap.

(b) If the typical school is to get this priority, the software for the technology should be generated to meet the requirements of students studying in such schools. An all-out effort will have to be made to understand hurdles that prevent concept formation and to prepare software accordingly. Buying software from the developed countries or copying it with only marginal changes, is sure to lead to disaster. Also a stage has come when it is necessary to take deliberate steps to make software available in Indian languages. "Why should the interface between an Indian and technology (of any kind) be in English?" It is not so in Japan or in any of the developed countries in the west which are smaller in size than a typical state in India. The whole concept of Indian scripts, Devanagari or others, being unsuitable for being used as an interface has been blown to pieces by examples from Korea, Japan and China.

Key Schools

The documents on new policy mention key schools to cater for talented students. One hopes that eventually, within a decade or so, a key school would be set up in every district in India. On the other hand, as one wathches the slow progress, one begins to wonder whether the entire scheme is going to be restricted to a few show-pieces. Also, identifying an already established school with considerable reputation, and giving it the status of a key school would be counterproductive. This trick may boost the total number of 'key schools' in the country, but the returns would only be commensurate with the investment involved in changing labels.

In any case, even assuming for the sake of argument that a large number of key schools would be set up, one should be concerned about special curricula for these schools. Should one aim at accelerating the talented students through normal school syllabi, or should one provide a

greater width and wider perspective so as to provide additional avenues to the extra intellectual capabilities of talented children? If so, how does one go about it? These are real problems that need considerable thought. One cannot merely invest in brick and mortar and hope that all other problems would sort themselves out.

Values in Education

Science and technology generate their own value systems. For example, S&T have placed in the hands of man extremely powerful tools for manipulating the environment. There are wise and not-so-wise ways of doing it. Also, for the first time in history, man can do much more than hoping and praying for the well-being of mankind. We have all the technology for providing clean drinking water and health services to our villages. However, one sees that 80 per cent people live in villages while 80 per cent doctors practice curative medicine in cities. Why is it that these aspects are not reflected in our curriculum? Certain priorities like reserving copper for taking electricity to the villages, not depending entirely on artificial fibres when we grow so much cotton, keeping public places clean, unpolluted and accessible to all, and teaching preventive medicine in schools, do not find a place in science curricula. This aspect needs immediate attention.

Utilising Field-tested Methodologies

There are several groups in the country who are addressing themselves to some of these important concerns. It should be the endeavour of national bodies like the NCERT to take the initiative and explore the possibilities as well as appropriate ways and means to incorporate research findings of these groups in national curricula. For example, the Homi Bhabha Centre for Science Education has developed a package of inexpensive remedial measure to boost the scholastic achievement of students coming from weaker sections of the society. This package has been field-tested and is so inexpensive that it can be incorporated in the regular school instruction as well as in teacher training institutions. Other groups like the Kishor Bharti have developed methods of integrating science education with rural developmental and awareness. One of the front task scientists in our country has considered it worthwhile to stay in a village in the Pune district in Maharashtra to develop a full-fledged course in appropriate technology, capable of boosting the earning capacity of school drop-outs. Why is it that these experiments, despite their proven merit, do not evoke any response from relevant quarters even when research groups with high credentials present them convincingly and repeatedly? Institutions that should be looking out for such experiments, become hurdles to be crossed or ignored. If curriculum reforms are not a single shot affair, and are expected to be an ongoing feature of our educational system, and if these 'reforms' are expected to improve the quality of education, national institutions in charge of education must develop sensitivity to innovations.

Give us the Tools

Some of the research findings have demonstrated the importance of giving tools rather than information and skills in schools. For example, tools of learning like surveys, data collection,

collecting and classifying specimens, studying open-ended questions, are shown to be very effective in boosting the scholastic achievement of even the underprivileged school children. Similarly, making a deliberate attempt at improving reading comprehension has also been shown to be strikingly effective. Now that we are going through the process of curriculum revision, we should take cognisance of these findings and make an attempt to incorporate them.

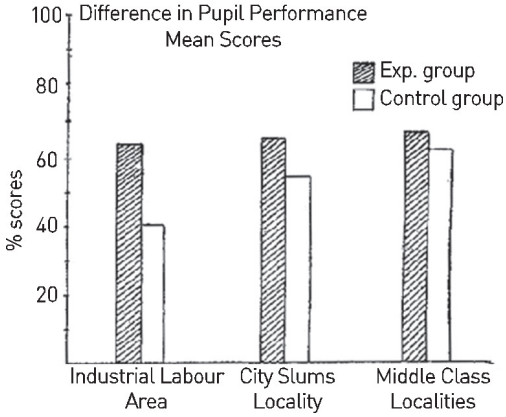

Fig. 3

In a large scale experiment undertaken by HBCSE, it has been shown that simplifying the language of exposition in science textbooks, not only leads to improved performance of students and to much greater teacher-pupil interaction, but also to reducing the difference in performance arising out of differences in home backgrounds. Since this finding has considerable social significance it is presented graphically. It would be a good idea to examine the textbooks for unnecessary linguistic difficulties and to simplify the language wherever possible.

The advantages of preparing an expanded version of the syllabus, mentioning specific objective, pre-requisites assumed, relevance to life, values to be highlighted, and, above all, indicating the end points beyond which the book would not go, were demonstrated in a collaborative programme for writing science textbooks. Since NCERT had taken the initiative in this programme, it would not be unfair to expect the NCERT not to ignore this very useful finding.