

# EDUCATIONAL TECHNOLOGY - THE FUTURES

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I have been tossing with a variety of ideas on "Educational Technology - The future". Three ideas that gained currency over a period of time are (a) reflection on methodologies of future forecasting, like future scan, Delphi, Scenario Building and/or trend analysis, technology assessment, etc. (b) technological developments per se and derive implications for educational technology and (c) to look at futures of educational technology in terms of management and planning implications.

I tend to believe that future of educational technology is in finding a match or fusion between accumulated human knowledge and wisdom, and massive illiteracy and non-performance in education. This statement warrants explanation of accumulated human knowledge and educational problems and an elaboration on how they can be brought closer to serve the human needs.

In the context of educational technology, the human knowledge can be classified into a few heads.

## **Human Learning**

Over the decades, the psychologists, particularly educational psychologists, have

made significant contribution to the understanding of processes of human learning. But the contributions that I wish to recollect and highlight are the contribution of Benjamin Bloom; I am referring to the concept of mastery learning. Several experiments all over the world, to which Indian researchers have contributed their own might, revealed that human learning can be designed in such a manner that most students would learn and master most of the learning contents and at various levels of cognition. Hence ball is in the court of curriculum planners and designers of learning systems and not on the 'intellect' of students alone..

Second contribution, I wish to recollect with you is that of Ausubel, particularly the concept of advance organizers and process of subsuming in enhancing relational learning and thereby longer retention. Again experiments have shown tremendous potential of structuring human learning using advance organizer.

Skinnerian and later developments in programming has almost assumed classical significance. Even if the romantic period of PLM is no more there; I suspect we are at a stage when we can recast "King is dead, long live the king" as "PLM is dead long live

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PLM". In designing self learning modules in print, computer aided instruction package, audio or video programmes, task and content analysis and small frame structured presentation are common procedures. Programming has become the basis of all software designing.

Interactive techniques as the hall mark of higher cognition have been experimented again and again, and has provided new understanding for achieving better human learning. In the recent years, interactive technologies have also been developed. Lookatch recently experimented and brought out that human interaction superimposed on interactive video is still the better alternative to interactive video alone.

Edward deBono's work on the other hand has indicated the possibility of training human minds in the process of thinking; and through lateral thinking the achievement of creative potential in humans. Computer scientists and psychologists have contributed the concept of algorithmic thinking; and taking a cue from the flowcharting exercises that it is possible to develop algorithmic thinking through a series of well designed exercises, and importantly even *without* the actual use of computer. A comprehensive summary is available in the paper by Dr. S.S. Kulkarni.

List of such contributions can be enlarged, but is not necessary with this galaxy of experts. My intention was to recollect that human wisdom has in its store the techniques of thinking, achieving mastery and means to achieve those; these are important since primary concern of educational technology is optimization of human learning. Alongside these developments in learning psychology let us review some of the developments in technology that has definite and serious

implications in organizing human learning.

### **Technological Developments**

The developments in informatics, telematics, video technology, optical communication during the last ten years have opened up radically new ways of transacting education within and beyond classrooms. Technology watchers and experts believe, there is much more in store than the eyes meet today.

Firstly, some experts predict that 286 (not even 386 or 486) based motorolla chips would provide the basis for single hole communication linking telephone, television, radio and all other possible communications. This would make it the household technology, leave alone the technology of the organized sectors including education.

Going into further details, now and more in the future, a computer can be a powerful tool in the classroom communication. It can work as a sophisticated blackboard or an electronic version of overhead projector, an electronic animator and tool for solving problems. As painted by experts, "to make possible a two way voice communication and a one way picture communication, all that is needed is a personal computer, an usual OHP with an additional LCD panel or projection video". An ordinary telephone line provide this linkage and would sharply bring down the cost to usual telephone cost. Rapid developments in technology would further enhance such possibilities.

The electronic media, from broadcast mode to video mode, is on the brink of a new generation of revolution. From the VHS low band system, developments in low band U-matic to high bank U- matic and now to high frequency beta matic system with far

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sharper and live picture quality indicates a great potential. And the developments have not stopped. Coupled with satellite technology and at the door step of many countries, either through their own satellite or through time sharing, the video communication, as much as computer communication, has almost reached a stage where limits can only be human imagination and ingenuity and not in technology. In fact it has brought the whole world so close. The CD Rom and now the video disc systems have totally changed the concept of information storage and retrieval; and not merely that, with increasing adoption of interactive technologies, these would come close to 'robot tutors' Writings on the wall are very clear that the technological growth and development would continue unabated and at a geometric proportion. With much of the cold war between super powers behind, chances have substantially increased that the fruits of such technology would find faster entry into education and other service areas in contradistinction to their application in defense and warfare.

The developments in printing technology and research in psychology of reading has also revolutionized the learning process. The design of reading material with variety of fonts which is ever growing in the hands of font designers, supported by desk top publishing system and table top offset printers. These new generation high-tech low cost technology has brought text design, illustration and production at the door step of every institutions. It is possible to imagine every teacher designing his/her own text and even students choosing their own fancy fonts and text layout to study. The technological developments have democratized the process. Satellite communication linked with printing technology has already made it possible to transport text across thousands and millions of miles without any risk of data

loss.

The developments in printing technology, text design and production increased efficiency in communication technologies has already given birth to open learning system which I suspect is the natural evolution to the next phase from classroom based education. important to note that technologies of the present and the futures is not only supplementing the formal education of the classrooms, but also trying to predict its capability as a stand- alone system.

The point, I wish to draw home at this point, is that technological developments during the last decade and with much more promise in the future is that computer, microprocessor technology will be the central piece of communication whether through telematics, satellite or computer itself. The cost of such technology is fast coming down in every country including the developing countries though the pace is slow. Secondly, these technologies are losing independent identities, rather isolation from each other. Much besides the point that computers can be networked from local to wide areas, technologies like video, telephone lines, computer projectors and satellite are getting networked to create a new hybrid band of communication technology with enormous power and penetration. Thus networked technology is the scenario of the future.

Thirdly, miniaturization would continue to be the order of tomorrow too. Computers are shrinking when their capacities are growing with replaceable hard disks, portable OHPs and episopes, small laptop computers, the enormous capacity of CD-roms and video discs are too well known to be described. Finally, technology with more and more miniaturization and

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sophistication are becoming easier and easier to use. From the angle of skill these are within easy reach of many, thereby breaking the age old elitist character of this technology.

Important point is to note that both in terms of our understanding how humans learn and the technology that could support human endeavors in learning is substantially rich.

## Education

Still education is one single sector that comes under fire every alternate day all over the world in the hands of politicians, administrators and users of product of the educational system; less in the hands of educationists, I suspect.

The World Education Conference of Jometien, in March 1990 was a landmark in educational soul searching. World over, there are massive illiteracy, large number of potential children remaining out of the framework of education, massive drop out neutralizing the effect of enrollment at the elementary grades of education, and poor performance, gross underachievement rather, of a large number of students at all levels. The problem is common all over the world despite there are shades of dark, grey and white - larger and more severe are the problems in the Afro-Asian countries than the European continent and the Americas.

Countries after countries, India is probably one of the best examples, have multiplied facilities in the form of setting up of schools within easy reach of children. The emphasis has been on supply planning and around the age old concept teacher as the only input required to run a school. Much besides the point that such an approach has disinterested even those who come to

schools, the countries have not taken seriously to demand generation for education. Result is nonviable institutions, parental aloofness, teacher indifference and abseteeism and system-tolerance and tolerance by the society of all this half hearted planning efforts without any social accountability.

The curricular non-relevance, disinteresting monotonous process of transfer of wisdom from books through the teachers' voice facilitating student drop out is a major problem. The social divide between the class of teachers and/or their values and communication styles and the students and children from the first generation learning homes also contribute to the phenomenon of drop out and under-achievement.

The educational software, largely the textbooks, are yet dull and drab; no comparison whatsoever with the reading material available from the market - look at the science series produced from Japan, China, USA, UK or India. The weakness of the humanware further aggravate the situation and quality of education all over.

With the fast changes in technology and science, and growth of knowledge, professional and academic obsolescence is another major phenomenon. The issue of continuing education is becoming increasingly important and relevant; question being asked is how frequent and in what kind of areas; what is the new techniques of learning to learn fast and better.

The problems in education elaborated more and more would paint a gloomy picture. There seems to be two feasible assumptions to explain the situation. One, human wisdom is incapable of finding

a mechanism to face the challenge of mass education, retention of students and above all to perform and bring out the best in the man/woman. Two, we have failed to master the knowledge and wisdom and press it to the service of the mankind and provide education. The stock of human wisdom briefly accounted earlier does not testify the first assumption that we as humans do not know the techniques. This brings us clearly to the domains of managing education and educational technology - latter to serve the former and that I suspect is the future.

The future can be described as value free description of developments of technology which I am afraid we cannot afford. The future has to be defined, defined in the interest of humanity. Future is in applying all that we know today and in store in future to educational developments; and applying to mass education thereby shifting the locus of application of educational technology from higher and professional

education. Latter is important from more than one reason - higher education stands on the foundation of mass education; more importantly, world over developments in technology and human learning are federally supported hence paid for by the common mass who has a natural right to the fruits of their own investments.

Even within mass education, it is possible to locate or define scope of the problem of education within formally defined boundaries of education. That appears to be too narrow a problem since education all over the world is not participated by all. For example, the highest participation rate in higher education in the world is only 33 per cent and only 4 percent in India. The regional disparity of educational participation of children in primary and upper primary grades also reveals wide gap between the potentiality and the actual participation (see table below)

**Table : Participation rate in Educational Age Cohorts**

Area	6-11	12-17	18-23	6-23
Africa	59.1%	46.4%	11.8%	42.5%
America	88.9%	75.7%	35.1%	67.5%
Asia	79.7%	43.0%	14.5%	46.1%
Europe	89.4%	81.8%	29.5%	66.2%
World	78.8%	52.2%	19.0%	50.9%

Source : UNESCO Statistical Yearbook 1989 : data 1987

Hence, defining the problem within education leaves out large majority of adults and children who are illiterates; and also it does not cover the need for continuing education in health, nutrition, vocational skill upgrading and living. The issue is hence much more broad based.

The issue is 'development'. Number of comparative international studies by

Amartya Sen, Partha Das Gupta, at micro level by Moonis Raza and Ramachandran indicate that the primary indicators of development are infant mortality, fertility rate, GNP, per capita earning, health care programme and provision, literacy rate, educational participation etc.

Leaving alone these macro level relational exercises, there are good number

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of micro level experiments which I have personally been involved with, have convinced me that education, earning, health and development are inseparable from each other. Communication and absorption of health or vocational information gets across better and more efficiently with education; similarly, minimum nutritional level is necessary for education to be fostered in the individuals. The point that needs to be underlined is that education cannot be seen and treated as an independent and isolated school based activity. The Future of education would have to have much broader connotation linking all aspects of life and living.

And, hence mass education is "the problem". The World Education Conference and subsequent policy paper proposes a time frame for achieving mass education in 90s. The positive enthusiasm indicated in this is refreshing and reassuring (though not necessarily pragmatic). Mass-education in tune with this enthusiasm has to be defined in terms of education for health, living, literacy, numeracy and achievement of minimum levels of learning.

This definition of the educational problem as well as the policy paper from the World Conference confront us with the threatening figure of millions of adult illiterates, millions of children yet to receive any kind of education and millions in schools to perform.

Can this be achieved through the known off-bit institutional methods? A major question that a group of expert teachers, trainers, educational administrators, planners, software designers and media managers like this, would possibly like to consider whether educational technology can play any role in this massive task of 'development'. It is rich with potentiality but

would it be chartered to perform this developmental role? If educational technology is called upon to play a meaningful role, its developments and application, would simultaneously define the future.

### **Tasks of Mass Education**

Let us at this stage try to define the tasks of mass education more categorically and then explore the role of educational technology therein.

- a) First stage would be to separate information from dis-information. Information that is developmental in nature is to be carefully identified and differentiated from dis-information. For example, message of health care, nutrition would have to be differentiated from beauty culture paying the way for promotion of consumer items like powders, perfumes and polishes which are dis-information.
- b) Second stage is to organize information around life. Classified information does and should provide the basis of curriculum. In order to make significant dent in mass-education, the information would have to be woven around life of the people.
- c) Third stage is devising information packages. The most common packaging of information is done in the form of textbooks. The emerging technology would provide newer and newer options in print and non-print modes in the form of audio video, computerization and variety of combination of more than one such mode at a time - video disc with all these modes put together and with random access. The major question of

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packaging the information is its capability of communication making it self-paced and with provision for differentiated learning.

- d) Devising delivery system is the fourth task. In lieu of formal schools as the only delivery system, new managerial challenge would be to deliberate upon alternative delivery mechanisms so that education is not only self-paced but also acquired at one's own time and place. Designing delivery mechanisms with own-time, own-place is not a cake walk but not impossible particularly considering the emerging educational technologies.
- e) Devising a management system for initiating, implementing and monitoring mass education in the new innovative management framework is the fifth challenge. While the information packaging and delivery would appear to be nonformal, its success will depend upon much tighter, well-designed management systems.
- f) Finally, the challenge is evaluating information and the information packaging so as to identify the changing scenario of 'development' - whether, or not, infant mortality rate going down, nutritional level going up, literacy level going up, etc.

### **Information Management**

As mentioned above, organizing information is, in the functional sense, curriculum design. The major shift in the future curriculum would be providing nutrition, housing, sanitation, health or care alongside literacy, numeracy, functionality, etc for social participation and development of vocational skills as the basis of curriculum.

The packaging of information can derive enormous benefit from the accumulated knowledge in educational technology - a wide range of techniques like door to door campaign, street play, lamp slide show, and such kinds of folk and localized modes. It also has the print mode in the form of books, programmed and semi-programmed materials, self-learning modules, illustrated magazines and newspapers, as well as newspapers for neo-literates. The emerging printing technology can revolutionize book design and production with enormous economy of scale in learning. Educational technology has also in its store the broadcast modes of radio and television with high frequency, low band/high band alternatives that can reach far and wide. It can as well get into a audio and video-the powerful mode that can be adapted to local needs. The experiences in the use of telematics in several countries provide yet another alternative. The emerging computer technology has not only revolutionized the use of computers in education but it is at the threshold of providing critical support in application of other technologies to newer and newer dimensions. The use of interactive video and now the computer communication through modem and other simple peripherals provide an altogether new level of efficiency and capability.

### **Planning and Management Dilemma**

Coming to the question of the systems, the future is in nonformalising formal education. Through the planned intervention in organized learning centers as well as in self-paced home based or on the job learning, educational technology and its ever developing capabilities can totally change the face of learning organization into more effective but nonformal ways. The structure of time tabling in the conventional

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systems would pave way for a more flexible and functional system.

Open learning system and distance education has come a long way all over the world. Open learning system are still seen and considered by some of the educationists as the second grade learning systems for those who could not intellectually afford formal education or missed the bus for some other reason. Some look at it as a parallel system.

Open learning system, in fact, is the natural development of classroom based education system. At least in India, the evolution can be traced from one to few Gurukula system. As and when demand for education increased, formal classrooms - one to many at a time - came into operation. We at this time are at a point where the "many" is too large to be even defined, and we need a newer system to cope with this. The parallelism is the transition from agricultural craft to industrial technology where the emphasis is on higher productivity with greater accuracy of quality control. Open learning system is the developmental response to this new need. Also, the technological developments have made it possible to decentralize the human expertise to be shared by millions at the same time, be it in print or in electronic media.

I have another point too in this regard. I do not even see OLS as an alternative system. Future is in fusion of formal and OLS and that is the key to noformalising formal education. A time should come when most learners should use OLS for basic learning and study and use the formal system for clarifications and tutorials, for inculcating such aspects of education that are not amenable through OLS technology. Similarly, students in formal system should and would take advantage of OLS. In other

words, I see these two components not in competitive terms in the future. The available studies, at least Indian research, indicate that OLS at the higher education level is as efficient in cognitive component, more cost effective in fact, as the formal system. Education is not merely cognitive development however. The inculcation of values and attitudes and emotive qualities are equally important, if not more. I suspect the future is in OLS for providing cognitive input at a much faster and penetrative way, and affective input coming through the interactive process with teachers and students in the formal systems. A judicious combination would form the basic corpus of the new educational system.

The use of mass media would provide a massive practical thrust to this new pattern of educational organization. Over the years its application in education has increased.

The use of mass media which more or less is the prime basis for a meaningful OLS also has to play a role in demand mobilization for education itself. In some of the countries it has been used well; Indian experiment on use of TV for demand generation for immunization, preventive healthcare against gastroenteritis, burns and eye care has been quite encouraging.

### **Teacher**

Teachers at all levels would remain the central piece of educational system and the process. But with the changing scenario and developments the role and functions would have to undergo changes. As the medical practitioners, engineers or printers have absorbed new developments in their fields and changed their operational style, teachers need to change the role from dispenser of knowledge which is no more stored in the teachers brain alone. It is

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equally stored with random access retrievability in other forms of technology. Teacher in the new role would have to play the role of information manager - collection, classification, organizing and storage, retrieval and dissemination. In many of the advanced countries and in a very small measure, in India, students with access to computers are designing their own software. This is not yet the case with the teachers - teachers should also take to software designing as a natural role following the role of information organizer. Teacher to come to this new role would need training of a fresh variety to change the skills and also the values. The training design should be such that 'media becomes the message' itself.

### Cost

Whenever the issues of educational technology is raised in the context of basic education/mass education, which essentially implies education for a larger number of people and the number is massive, the question of cost is raised. The assumption is that educational technology increases the cost of education. This incidentally is not well-founded, particularly in the context when more than 95 per cent of the educational cost is teacher cost and that quality is in variance. Educational technology in a varying teaching quality can be a good compensator, it would also become a countervailing force.

Coming back to the question of cost, it is important to be clear on the 'high cost' and 'low cost'. It is one thing to talk about unit cost per aid (hardware or software), it is altogether another to consider unit cost per learner in the context of use of educational technology. The economic study of Singh (1988) revealed that all Indian children covered through "television" would cost 1/7th of all children being covered by "low

cost teaching aids". Instead of television, if the educational system opts for video mode, it would still cost 1/4th of that of 'low cost aids'. It is important to recognize that high-tech is not only more powerful in terms of packaging and communicating information, it also achieves greater economy of scale.

### Software

The next issue is with regard to relevance of the software that could be transmitted through the high-tech media. The argument that has again emerged with the policy paper following the World Conference is 'reversal to folk media'. the primary argument is the lack of relevance of the electronic mass-media which by nature more cosmopolite (urban and consumerist!) vis-a-vis culture. Many micro-level experiments have revealed that folk and local media can make people more responsive. This is also corroborated by the famous work of Paulo Friere. This dichotomy between relevance and media power could be resolved by making media as the mirror image of folk. The message can be communicated through folk modes and enactment of folk practices.

The second aspect is the conventional criticism of educational software being dull compared to entertainment modes. These are not necessary contradictions. Education can be communicated through entertainment mode as well. Several experiments have been carried out in many countries on using entertainment mode for education and communication of development information. One of the recent developments in the Indian television is the communication of health messages through "Nukkad" group (street corner group), encouragement of the girl child through attractive ad modes.

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The third aspect of the future is the software that can be commonly shared by all members of the family. As of today, the softwares are used which differentiate the members within the family between age and sex and interest groups. In order to generate mass education, new kind of software will be necessary to make it viewable by the entire family.

### **Conclusion**

The concluding comment of my submission is - we collectively have the understanding of how humans learn and can do better, we also have the techniques and technology to revolutionize the process. The federal government all over the world have funded research and development which today has given this peak of knowledge. It is the same federal governments that set up, maintain and nurture the educational systems for mass education. In framing policies and practices, however, the knowledge emanating from research is not adequately accommodated. As such research and development remain in isolation from actual field operation. What is missing is the state will to transfer technology and modern scientific techniques to the cause of mass education. The fact that we

have heart foundations but not rural maternity facility or potable water, or centers of excellence of learning parallel to appalling illiteracy and nonperformance are the clear indications of lack of will and not lack of technology. Can educational technologists, teachers and administrators, software designers play their role to create a countervailing force on the state systems and prevail on them so that fruits of scientific and technological developments are shared with all those who hold the share?

I suspect, future of educational technology is not in sophistication of learning psychology, software and hardware designs in the Ivory Towers and serving the small minority of information rich community. Its future lies in the social choice, its application in social welfare in the form of eradication of the human shame, shame of illiteracy and in-education. In the language of Rabindranath, "This is my sin, you too have done it. The dark cloud around the corner of the sky is the heat in the heart of God accumulated over the centuries". Do we wish to respond to this?

There is a wide gap between "can do" and "will do". I am confident we (the human) can do it; but will we?

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