INFORMATION COMMUNICATION TECHNOLOGIES AND EDUCATION

P V UNNIKRISHNAN, E M SREEDHARAN

1. Introduction

Information and Communication Technologies[1.] (ICT) have started occupying the centre stage of social and economic transformations in both the industrialised and developing countries. The costs of these technologies had been falling continuously and as this happens, the capabilities of the technologies had been increasing steadily[2.] and they are being applied more and more to various sectors of economies and societies. The confluence of computing, audio visual and telecommunication technologies on the one hand[3.] and the spectacular advance in digital compression technology[4.], during the last two decades have drastically transformed the way information is accessed and assimilated on a global scale. People communicating now, have powers of transmitting and receiving information, undreamed of even ten years ago.

The processes of creation, dissemination, storage and management of information have transformed and new society models for sustainable development in which information embedded in ICT systems are combined productively with the creative potential and knowledge embodied in people, called *"Knowledge Societies"* are being propagated, by various international agencies[5.]. In the context of knowledge societies, perceptions of the scope of education also are changing as societies come to recognise that *"the time to learn now is the whole life time and not just during the period of childhood and youth"* [UNESCO (1996)]. The impact of ICT on education is candidly described at the documents of the Inter Agency Commission for the World Conference on education for all - "*New possibilities are emerging which already show a powerful*

impact on meeting basic learning needs, and it is clear that the educational potential of these new possibilities has barely been tapped. These new possibilities exist largely as a result of two converging forces, both recent byproducts of the general development process. First, the quantity of information available in the world – much of it relevant to survival and basic well being – is exponentially greater than that available only a few years ago, and the rate of its growth is accelerating. A synergistic effect occurs when important information is coupled with a second modern advance – the new capacity to communicate among the people of the world. The opportunity exists to harness this force and use it positively, consciously and with design, in order to contribute to meeting defined learning needs". [World Conference on Education for All (1990)].

2. Oppurtunities for Education

Educationists have begun to realise that personal computers, with their convenient keyboards, small monitors, pointing devices such as joysticks and mice with multimedia capability and ability to link with note books and 'laptops' or 'personal computers' of others or even with digital libraries, have evolved into personal media which can facilitate effective learning environments. Most of the educational features of the older media like books, radio, film strips, phonograph records and television are available with the networked multimedia PC, the most promising additional feature being the communication capability. The following aspects of the new technology are worth mentioning.

1. The connectivity of the Multimedia PC can have beneficial implications on extended interaction between teachers and students, opening up new opportunities in educational methods. It caters not only to teacher – learner interaction but to learner – learner and teacher – teacher interaction as well. Virtual learning environments, which can

provide interactive learning environment similar to a real one, but not in a physical class room or lecture theatre, with the learners not even active at the same time have been developed. These learning environments have capabilities to enhance student learning processes in a variety of orthogonal dimensions like visualisation, diagnosis, remediation, reflection, memory prostheses, scaffolding, tackling the hypothetical, timeline, autonomy, pacing, redundancy, motivation, group working, knowledge integration and access[6]. [UNESCO (1997)]

2. With the advances in Internet and World Wide Web Technologies and the ease with which enabled text, audio and video material can be stored on compact disks, the multimedia personal computer has become a very convenient and proficient tool for delivering support and enrichment of the existing curriculum. Today a large number of a geographically dispersed, interconnected virtual libraries of documents are available to anyone with a computer, a modem and a telephone, if the data carrying capacity of the telephone line is reasonably good. With this level of access to the web technologies and the television channels, teachers in industrial countries are facing a different kind of student from the one he or she knew when first taking up teaching.

3. Challenges in tapping the potential of ICT'S for education

1. Over shadowing the use of Information and Communication Technologies in education are the global disparities in the access of these technologies. Statistics on the status of a handful of communication indicators are tabulated in Table - 1 below:

The disparities are more profound if we look at the distribution of mobile telephones, PCs and Internet hosts [UNDP (2000)][7]. This clearly stands out as a serious barrier in making use of the new digital communication and information technologies in education. The legacy of the disappointing experience with older technologies, like film strips, radio and television, which once expected to transform education thoroughly, adds to this[8]. It has been also pointed out that the status of education sector in developing countries, where essential and low cost technologies are desperately under funded (chalk boards to text books) can hardly represent a promising arena for costlier innovations[9].

Table - 1

Selected Communication and Media Indicators region wise, 1995

Sl. No.	Name of the Indicator	Regions[10]						
		Least Developed Countries						
		Sub Saharan Africa	Arab States	Latin America / Carribbean	Eastern Asia / Occania	Southern Asia	Countries in transition	More developed Countries
1	Copies of daily newspapers per 1000 habitants	12	27	37	57	80	114	288
2	Radio receivers	88	169	199	251	387	403	1287
3	Television receivers	33	43	109	170	192	318	625
4	Telephone main lines	11	15	44	46	90	158	534

Note :- **The corresponding indicators for India (1995) are**

Daily newspapers per 1000 inhabitants	-	32
Radio receivers per 1000 inhabitants	-	81
Television receivers per 1000 inhabitants	-	51
Main telephone lines per 1000 inhabitants	-	13

Source : UNESCO

2. Another crucial issue is teacher training. How computers are used in education, depends on the pedagogical competence and technical skills of the teaching staff who must know how to exploit these technologies in pedagogically meaningful ways. Teachers training should cover skills in handling and maintaining equipment and software, integration of ICT's into the curriculum as well as skills for an active role in creation of ICT content. The argument that ICT's can replace or substitute teachers doesn't really make sense[11]. The so called new approaches of ICT based learning described as 'experimental learning', 'enquiry learning', 'learning by discovery' and 'open class room' approaches are nothing but learner centred techniques. These approaches are not all new and have infact no relation to technology as such. They have evolved out of discussions in from early twentieth century among educators in evolving the 'psychological method of learning'[12] as different from the 'logical method of the expert'[13]. Training the army of teachers in the developing countries in the new technologies and in the meaningful use of such technologies is by no means an easy task. The task of equipping teachers to contribute seriously to ICT content development is even more challenging. A process of continuing education or continous learning in which teachers as

practitioners periodically update and renew their knowledge, skills and capabilities alone would be rewarding.

3. The third crucial issue is of producing locally relevant content - Educational software is usually language, culture and locale specific, and rightly so. Adapting software across national boundaries, has not been very productive, as it is now for international exchange of textbooks. This would therefore mean that extensive efforts would have to go in for creating meaningful content based on the local curriculum. Like the development of good textbooks the development of good educational software will also follow a long term process of trial and error. This will need educational institutions to continuously draw on the experience of the best teachers, those who are the most observant of, sympathetic and skilled in responding to the learning needs of individual pupils.

4. Last but not the least is that the commitment of most countries to democratisation of education (Educational for all and education through out life) is being influenced by a process of retrenchment and restructuring of public expenditure, including expenditure on education, even in the developed countries. In the developing countries where population pressures are strong the pursuit of education for all goals is often constrained by structural adjustment programmes. That even in the light of the widely proclaimed commitment towards education for all to the education sector could not benefit significantly from the relaxation of international political tensions in the form of a peace divident from reduced defense expenditure, an expectation that nourished in the late eighties, is a clearly manifestation of the lack of political will provide

adequate resources for educational infrastructure, teachers training and for improving the lot of the teachers.

4. An analysis of the information technology policy initiatives in the states

Information Technology initiatives in India, till recently, had been by and large, initiatives of the Government of India through the National Informatics Centre barring a few adhoc efforts by certain state government departments. There has been a paradigm shift recently from the traditional centralised public sector led investments towards state government initiatives with private sector participation. This is mostly the outcome of the implementation of local ICT strategies by various state governments.

Karnataka was the first state to adopt an IT policy in 1997. Maharashtra, Tamilnadu, Kerala and Andhra Pradesh took the cue and followed soon. In May 1998, the central government adopted the recommendations of the National Taskforce on Information Technology and Software Development that each state government should formulate an IT policy. As many as 14 state governments have set up IT Departments and budget allocations are being set apart for IT promotion. In several states task forces have been set up and action plans have been firmed up.

IT industry associations such as the National Association of Software and Services Companies (NASSCOM) the Confederation of Indian Industry (CII) and local chambers of commerce have been actively lobbying with various state governments for incorporating incentives for private investment and for strengthening of infrastructures.

The focus of the provisions in the IT policy declaration in various states relating to human resource development and content development has been consolidated in Table – 2 below :

Note :- Information Technology policy documents for Andhra Pradesh, Karnataka, Tamilnadu, Kerala, Maharashtra, Punjab, Madhya Pradesh, Delhi, Rajasthan, West Bengal, Haryana, Assam, Goa, Gujarat, Orissa, Pondicherry, Uttar Pradesh, Chandigarh and Tripura have been examined.

The Table – 2 reflects only the explicit policy declarations in the policy document. In many cases the policy declarations don't necessarily represent the implementation status and progress of IT implementation in the state. Many of the late starters like Delhi, Rajasthan, Madhya Pradesh etc., had the advantage of consolidating the experience of the earlier starters and incorporating them into their policies. However our limited objective to analyse the overall policy frame work of ICT implementation in the states can be easily achieved from this.

1. The focus on ICT in schools and colleges is a very prudent step and would bear fruits in the medium and long run. In states with lower literacy levels this could be the first step towards ICT dissemination and promotion of computer literacy. To what extent the centres of excellence would strengthen local industry and local ICT initiatives would however depend on how effectively these centres are networked with the local needs and programmes.

2. The focus on ICT enabled education is rather limited and rightly so, since the ICT infrastructure is inadequate and so are the resources. The challenges in ICT enabled education are tremendous and no state has dared to declare it as a policy initiative. Training of teachers in ICT and ICT training in schools is the major thrust. These efforts in the long run would be beneficial for initiating

programmes for ICT enabled education as and when appropriable infrastructure is available.

5. ICT Perspective for kerala

The IT policy for the Kerala State stands out on two counts

i. The unqualified emphasis in the policy document on ICT dissemination and diffusion is significant.

ii. The policy explicitly declares its commitment to implement local body computerisation, to extend citizen services through the local bodies computerisation programme and to use ICT for empowerment of the people and for fulfilling the right to information of the community at large.

The policy also has a distinct focus on developing resource based information system[14.] for the state, which could evolve as the knowledge base for the decentralised planning programme and other developmental initiatives in the State. This in turn could be the centre around which an integrated decision support tool for planning and management could emerge.

The Information Technology Policy document has benefited from two earlier initiatives of the State Planning Board in formulating a development-centred and bottom-up ICT outlook.

1. The report of the task force on electronic media.
2. The Pilot project proposal for a State level informatics system for strengthening the people's planning process and decentralised plan implementation.

The relevance of an ICT strategy based on the above viewpoint is that it has been formulated with a candid understanding of the issues in Kerala's development.

The most crucial implementation of Kerala's ICT strategy is a programme for computerisation for local bodies which has been initiated with the support of the Planning Commission. A mission team called the Information Kerala Mission has been set up for the purpose. The Information Kerala Mission has evolved a human centred perspective[15.] for ICT development and deployment, which includes participatory software development, local entrepreneur based support network and an activity-based user centred training programme in Malayalam focusing on demystification of technology [Unnikrishnan, P.V. and Sreedharan, E.M. (2000)]. A series of software applications for participatory e-governance, IT enabled services based on a citizen's database, Geographic Information System (GIS) based resource management tools and community portals for developmental intervention[16.] and transparency in public administration are being developed. A few of this applications have already been deployed on a pilot basis [Unnikrishnan, P.V. (2000)].

Even though ICT enabled education does not figure in the states IT policy the State Government has recently declared a programme IT @ school based on an IT in Education Vision 2010. The programme aims at *"creating a new generation of thinkers, professionals, scientists, technologists and entrepreneurs who will be able to instantaneously access and use any relevant information using IT as a tool"* [Government of Kerala, 2000]. The three year project IT @ school is a very ambitious one with no parallel in the rest of the country. It talks in detail about resource mobilisation, hardware procurement, infrastructure build up, integration of ICT in the curriculum and also teachers training. However the

aspect of content has not been seriously looked into. The proposal possibly takes a view that the content has to be generated outside the framework of the schooling system by various private vendors, which could be unreasonable and short sighted.

Criticisms have come up from various quarters regarding the project in the background of overall priorities to be fixed in education in the state. The arguments have been as follows:-

1. Kerala has embarked on a process of curricular regeneration which involves replacement of conventional and outdated syllabus, curriculum and pedagogy by child friendly and activity oriented ones. Necessary changes in classroom practices, evaluation techniques and community participation are being brought about. The process has hardly stabilised and the process of teachers training at various stages are going on. In teachers training and in developing the new curriculum the state is struggling to mobilise adequate expertise. Taking up a major initiative like IT @ School at this juncture would result in spreading the resources too thin and would affect the quality of education imported.
2. The infrastructure available in Kerala schools is still not up to the mark inspite of the systematic efforts by the local bodies in building up of infrastructure, as a part of the peoples plan programme[17]. There is danger of the new programme of IT @ school, cutting into the available resource for improvement of existing infrastructure and curriculum regeneration could result in stewed or lop sided implementation, unfairly affecting the student community.

3. Another major issue is that there is very little experience in digital content development in the state. The State Council for Educational Research and Training (SCERT) and the State Institution of Educational Technology (SIET) have done hardly done anything in this regard. The only agency which can claim any expertise in content generation for educational technology is the Centre for Development of Imaging Technology (C-DIT) [18]. No serious effort has been made by the State government to handle the issue of content development so far.

The weakness of the IT in Education Vision 2010 and the project IT @ Schools is that they have by and large failed to understand the dynamics of the achievements of the State of Kerala in literacy, educational development and education reform. The achievement that Kerala has made in the educational sector have been by and large achieved by integrating the process of education with the overall development initiatives. The efforts towards addressing certain crucial weaknesses of Kerala's achievements, which have come to light in the late eighties, like lower achievements of marginalised sections, poor infrastructure in schools and quality of education have also been centred around voluntary organisations mainly Kerala Sastra Sahitya Parishad[19], District Panchayats and the People's Planning programme.

The project IT @ schools also doesn't envisage networking with various other ICT initiatives in the state. This can also turn out to be costly since successful implementation of the project at level requires lot of inputs for managing the ICT infrastructure as well as for content generation and improvement Banking on available strengths, would definitely be prudent measure.

Last but not the least, detailed discussions with educational movements, teachers organizations and local bodies would also come in handy in making them active partners in these pioneering ventures.

6. Conclusion

Information Communication Technologies offers a lot of potential for improving the quality of education. Just as applying ICT in development sectors cannot be considered as quid pro quo to strengthening the basic economy, ICT enabled education cannot be an alternative to the ongoing efforts in strengthening of physical infrastructure, regeneration of curriculum using non ICT methods, and teacher empowerment. The initiatives in the country to apply ICT for curriculum enrichment are in the initial stages. Kerala has initiated a pioneering effort in this regard. This effort has to be integrated with the overall programme for physical infrastructure strengthening and quality improvement on going in the state as a part of the people's plan programme. Efforts should be also made to ensure the partnership of local bodies and voluntary organisations in these efforts inorder to ensure success.

BIBILIOGRAPHY

1. Government of Kerala (2000), "IT in Education Vision 2010". Report of the IT - Task Force for the Department of General Education, Government of Kerala", November 2000.

2. Tharakan, Michael, P.K. (1999) "Community Participation in School Education, Experiments and Experience under People's planning campaign in Kerala", International Conference on Democratic Decentralisation, 2000 May 23-27, Thiruvananthapuram, Kerala.

3. UNDP (2000), "Human Development Report 2000", United Nations Development Programme.

4. UNESCO (1996) “Learning : The Treasure within Report to UNESCO of the International Commission on Education for the Twenty-first century”,

5. UNESCO (1997), “Virtual Learning Environments and the Role of the teachers : Report of UNESCO", Paris.

6. Unnikrishnan, P.V. and Sreedharan, E.M. (2000), “Information Kerala Mission – Evolution Methodology and Context”, International Seminar on Democratic Decentralisation, Technopark, Thiruvananthapuram, May 23 – 27, 2000.

7. Unnikrishnan, P.V. (2000), “On the Eve of Unfolding of a Silent Revolution”, The Deshabhimani Malayalam daily, 23 November 2000.

8. World Conference on Education for All (1990), Meeting Basic Learning Needs Jomtien, Thailand, 1990.

Notes :-

1. The following definition based on revision 3 of International Standard Industrial Classification (ISIC) has been broadly agreed to as the definition of the ICT sector.

Manufacturing

- 3000 – Office, accounting and computing machinery.
- 3130 – Insulated wire and cable.
- 3210 – Electronic valves and tubes and other electronic components.

- 3220 – Television and radio transmitters and apparatus for line telephony and line telegraphy.
- 3230 – Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods.
- 3312 – Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process equipment.
- 3313 – Industrial process control equipment.

Services

- 5150 – Wholesaling of machinery, equipment and supplies*
- 7123 – Renting of office machinery and equipment (including computers).
- 6420 – Telecommunications.
- 72 – Computer and related activities.

* limited to include only the wholesaling of ICT goods as shown in the Manufacturing component of the definition shown above.

2. Gordon Moore, one of the founders of the Intel had deduced a law in 1965 which has dictated the evolution of microprocessor power ever since – *"Microprocessor power doubles every eighteen to twenty four months."* Thirty five years later, the Moore law can still be seen to hold true. The power of semiconductors doubles every two years with a corresponding drop in price performance ratio. The storage capacities of hard disks used in microcomputers are also steadily increasing along with the miniaturisation of components and memories. Meteoric changes such as these provide the new information and transmission support media with fabulous powers of communication.

3. The emergence of the digital technology, (ie. coding of signals into strings of numbers in binary form as packets of 0 and 1) has resulted in the technical convergence of telecommunications, computer and audio visual technologies, which were previously separated by techniques, legislation and modes of distribution. This has also resulted in

functional convergence as a result of which have originated from, these hitherto distinct segments, hybrid services, like video on demand and interactive services. Corporate convergence arising out of diversification of companies involved in the traditional sectors into the hybrid sectors and agglomerations and mergers of existing corporates are also evident. Communication systems have unified, to such an extent that telephone calls and television pictures new no longer be transmitted on separate transmission media. Personal computers and television sets are one and the same thing, telephone messages can use the internet and the portability of laptop computers are tremendously enhanced by mobile technologies.

4. The advantage of digital technology vis-a-vis analog technologies is the higher reliability. However digital signals are more demanding in terms of the transmission technology. Digital compression technology has solved the difficulty by reducing the flow of information and time of transmission which inevitably reduces the cost of transmission without loss of quality and content.

5. See for instance the Reports of the United Nations Communication on Science Technology and Development (UNCSTD) and the International Development Research Centre (IDRC) on *"Knowledge Societies."*

6. Dimensions and Scope of Virtual Learning Environments

Sl. No.	Dimension	Scope
1.	Visualisation	Support for abstract process and procedures through simulation.
2.	Diagnosis	Analysis of accidental errors.
3.	Remediation	Remediation on areas that the student requires to focus.
4.	Reflection	Reflection on one's own learning process.
5.	Memory prostheses	Selective memorisation for greater cognitive economy.
6.	Scaffolding	Dynamic variation of scaffolding level provided for learners.
7.	Tacklingthe hypothetical	Investigation of fundamental principles based on analysis of counter factual situations.
8.	Time travel	Time travel as a routine in simulations for learning chronology and causality.

9.	Autonomy	Emphasis of the learner's viewpoint in designing instructional material.
10.	Pacing	Clock based planning for work of a cohort of learners.
11.	Redundancy	Heterogeneous groups of learners with different learning styles and preference take advantage.
12.	Motivation	Enhancement of motivation based on personal traits of learner.
13.	Group working	Supports synchronous or asynchronous group working modes.
14.	Knowledge integration	Student can integrate diverse knowledge acquired at different times by using media redundancy and memory prosthetics.
15.	Access	Extended access of learners through the additional features listed above.

7. The Human Development report 1999 carries extensive documentation on the digital divide arising out of the inequality in access to the emerging network society. The report points out that a widely acceptable measure of basic access to telecommunications is having 1 telephone for every 100 people – a teledensitry of 1.Yet as we enter the new millennium, a quarter of countries still have not achieved this basic level.

Thailand has more cellular phones than the whole of Africa. The United States has more computers than the rest of thee world combined and more computers per capita than any other country.

In mid- 1998 industrial countries – home to less than 15% of people – had 88% of Internet users. North America alone- with less than 5%of all people-had more than 50% of Internet users. By contrast South Asia is home to over 20% of all people had less than 1% of the world's Internet users.

8. Many experts argue that there are signs that new digital information technologies, in contrast to earlier technologies which never delivered on promises to transform education could be drastically different, for it has already begin to delve into

the core process of education, in a way many other technologies never managed to do. Integration of multiple media, interactivity, flexibility of use and connectivity distinguish digital ICT from previous technologies and these differences come in handy for educators to integrate digital ICT's into the curricula.

9. A UNESCO - UNICEF study undertaken in primary schools of 14 less developed countries indicated that in ten out of fourteen countries surveyed one third or more of pupils are gathered into class rooms without a usable chalk board. In virtually all countries there are no teaching aids such as wall maps and almost no pupil will ever see a world map. In ten out of four teen countries, one third or more of the pupils are in classrooms without a teachers' table and the situation is only marginally better with respect to a chair for a teacher. In eight out of fourteen countries, 90 per cent of pupils attend schools which do not have electricity, almost as many attend schools without piped water and one third or more of the people attend school which do not have water at all. Moreover in half of the countries (mainly in Africa) over 90 per cent of the pupils in the final grade of primary education do not have any text book in the mother tongue, over a third of them do not have a maths text book in any tongue and over a third do not have a desk or a writing place as distinct from just a place to sit.

Source : UNESCO (1995). "The conditions of primary schools : A Pilot Study in the Least Development Countries. A report to UNESCO and UNICEF, Paris, UNESCO 1995.

10. More developed countries comprises of Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Portugal, San Marino, Spain, Sweden, Switzerland, United Kingdom and the United States of America.

Countries in transition include Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Poland, Republic of Moldova, Romania, Russian Federation, Slovakia, Slovenia, Tajikistan, The Former Yugoslav Republic of Macedonia, Turkmenistan, Ukraine, Uzbekistan and Yugoslavia.

Sub-Saharan Africa includes Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principle, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

Arab States includes Algeria, Bahrain, Bahrain, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Mauritania, Morocco, Oman, Palestinian, Autonomous Territories, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates and Yemen.

Latin America and the Caribbean includes Antigua, Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, British Virgin Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay and Venezuela.

Eastern Asia and Oceania includes Brunei Darussalam, Cambodia, China, Cook Islands, Democratic People's Republic of Korea, Fiji, Hong Kong, Indonesia, Kiribati, Lao People's Democratic Republic, Macau, Malaysia, Mongolia, Myanmar, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Solomon Islands, Thailand, Tonga, Tuvalu, Vanuatu and Viet Nam.

South Asia includes Afghanistan, Bangladesh, Bhutan, India, Islamic Republic of Iran, Maldives, Nepal, Pakistan and Sri Lanka.

11. There is an argument that students should be as independent as possible and should be encouraged to become interest thinkers. For argument sake, even if we accept this, I don't thing that anybody would contest the role of the teacher in the development of the curriculum content.

12. In the psychological method of learning, problems selected from material of ordinary acquaintnance are chosen and methods by which scientific persons have reached their perfected knowledge are followed through which the learner understands, within his or her range, what the scientific method is.

13. In the logical method of the expert the subject matter in the perfected form is presented leaving out the irrelevant. Technical concepts and definitions are introduced at the outset, followed by laws with indications of how it was carried out. The approach here is that of an advanced student, who might possibly become an expert later on.

14. The resource based information system envisaged shall encompass a comprehensive socio economic citizen profile, similar to the social security data base in the United States, linked to geographical information system consisting of spatially referenced land, water and cover information. The information system shall be used as a decision support system for integrated and sustainable resource based planning at the farm, watershed, panchayat and block level on the one hand and urban infrastructure and services management system on the other. ICT enabled citizen services shall be also linked to this.

15. The human centred approach to information systems is based on the so-called soft methods. It is argued that traditional engineering approaches are hard or functionalist, being based on a view of world which sees it as composed of determinable, rule based systems. Soft methods by contrast, take an interpretivist, ideographic stance: the world is seen as determinable only from the viewpoints of human participants. It is widely argued that whilst hard methods give rise to a systematic approach to information systems, soft methods typically rely on a more holistic, systemic view, which it is maintained are more representative of the domain.

16. This portal would be a clearing house for science and technology inputs for micro level development and could also facilitate marketing of products and services,

resource mobilisation, technology tie-ups and also provide inputs for project monitoring and management.

17. A detailed description of community participation in school education is available in "Communication Participation in School Education, Experiments and Experience under People's Planning Campaign in Kerala," P.K. Michael Tharakan, Paper presented at International Conference on Democratic Decentralisation, May 23-27, 2000, Thiruvananthapuram.

18. C-DIT had developed a series of educational videos in 1997 and 1998 for the District Panchayats in Kerala. These videos focus on improving learning and teaching of the more difficult concepts in the high school curriculum.

19. Prof. Michael Tharakan in his study on Community participation vocally describes the role of KSSP involvement as follows. *"One abiding factor in all stages is the strong presence of KSSP. One wonders whether the idea of community intervention would have survived but for the presence of KSSP activities".* [Michael Tharakan, (1999)]