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Barriers to Utilizing ICT in Education in India with a Special Focus on Rural Areas

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ABSTRACT:

In a developing country like India, lack of technology, internet access, and qualified trainers act as the biggest challenge in providing ICT-based educational services to the masses, especially to the rural masses. Three-quarters of India's total population reside in the rural areas and 30 percent are below the age of 15 years in their peak formative years of schooling. Nearly a third of rural India is still illiterate. In this situation, ICT enabled education in rural areas can be an innovative option to fill this literacy gap and to upgrade the teaching-learning process in the rural schools for tapping the huge reserves of human resources. This study explores barriers to utilizing information and communication technologies (ICT) for teaching and learning process in the country of India as indicated by participating stakeholders: students, teachers, and administrators and also suggests some suitable solutions enabling smooth implementation of ICTs in rural education sphere with utmost impact.

KEYWORDS: ICT, IT, Education, Quality Education, education, rural, school

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INTRODUCTION

One of the biggest concerns of educators across the world, and especially in India, is making the present generation of learners future-ready. India is relatively young as a nation with around 28 million youth population being added every year. More than 50 per cent of its population is below the age of 25 and more than 65 per cent are aged below 35. In 2020, the average age of an Indian is expected to be 29 years, while it will be 37 for China and 48 for Japan[1]. However, India's high youth population won't be of help to the economy if universal education is not achieved all over India. The development of a country primarily depends on its education system. Literacy is another proper indicator of economic development. In case of India, it is still developing nation since its education system lacks behind than many other developed nations, it is important that we must understand the need of education and its role in carving future of Indian youths. Information Technology plays a very vital role in developing the rural education system in India as well as it ensures awareness among the rural population about importance of education.

Michiels and Van Crowder[2] have defined Information and Communication Technologies or ICTs as "a range of electronic technologies which when converged in new configurations are flexible, adaptable, enabling and capable of transforming organizations and redefining social relations. The range of technologies is increasing all the time and there is a convergence between the new technologies and conventional media". There is no conclusive research to prove that student achievement is superior when using ICTs in the education space, either in the developed or in developing countries. However, there is a general consensus among practitioners and academicians that integration of ICTs in education has an overall positive impact on the learning environment. ICTs have the potential to innovate, accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change Lemke and Coughlin[3]; Davis and Tearle[4]. ICT as Medium of Teaching and Learning refers to the tool for the purpose of teaching and learning itself. More than three decades ago, computers and related information technologies were introduced to educators for direct teaching and learning purpose. It started with CAL/CBT/CAI, then moved to Multimedia courseware and finally to Web Based instruction & Computer Mediated Communication (CMC) system. Using CAI for drill and practice of basic skills can be highly effective according to a large body of data and a long history of use[5]. Students usually learn more, and learn more rapidly, in courses that use computer assisted instruction (CAI). This has been shown to be the case across all subject areas, from preschool to higher education, and in both regular and special education classes. Effective instruction requires

presenting information, guiding the learner, practice, and assessment of student learning. The use of a computer to provide any combination of these factors may be termed computer-assisted instruction. It should be noted that there is no requirement that the computer provides all of these elements. Rather, any combination of these can be appropriate computer intervention in the learning process. Interactivity, flexibility and learner control is the hallmark of these technologies. The application of educational technologies to instruction has progressed beyond the use of basic drill and practice software, and now includes the use of complex multimedia products and advanced networking technologies. Today, students use multimedia to learn interactively and work on class projects. They use the Internet to do research, engage in projects, and to communicate. The new technologies allow students to have more control over their own learning, to think analytically and critically, and to work collaboratively. An increasing body of evidence suggests positive results of the ICT integration with teaching and learning[6].

However, in India benefits of ICTs is not reached expected level in the rural areas still the rural population living with minimum level of ICTs facilities especially the poorest of the poor. Both Central and State Governments and NGOs are allocating huge amount for the development of ICTs and rural education. Yet the level of improvement and inaccessibility of ICTs in rural schools did not reach the expected level. This paper attempts to find out the loopholes and to give ideas to improve the rural education through ICTs, especially the computer related technologies. Also provide some suggestions for effective implementation of the National Policy for ICT[7] in education in rural areas.

NEED FOR ICT IN EDUCATION

Information and Communication Technologies are defined as all devices, tools, content, resources, forums, and services, digital and those that can be converted into or delivered through digital forms, which can be deployed for realising the goals of teaching learning, enhancing access to and reach of resources, building of capacities, as well as management of the educational system. These will not only include hardware devices connected to computers, and software applications, but also interactive digital content, internet and other satellite communication devices, radio and television services, web based content repositories, interactive forums, learning management systems, and management information systems. These will also include processes for digitisation, deployment and management of content, development and deployment of platforms and processes for capacity development, and creation of forums for interaction and exchange. ICT has become part of everyday life and all sectors from banking to tourism now depend heavily on ICT for carrying out

their transactions. The National curriculum framework 2005[8] has highlighted the importance of ICT in school education. Why do we need ICT in schools? Was education not happening before computers came into existence? Why is this paradigm shift necessary? The shift is necessary because this is the age of information and technology, an age that requires that teachers facilitate the gathering of this information and not merely teach.

Unfortunately, in India, ICT is largely associated with the use of computer and Internet. What one uses ICT for and how one uses it, is not addressed sufficiently. Schools and colleges acquire computers, Internet connection, LCD projectors and then send their teachers for crash courses that supposedly teach them to use technology. The trouble is this whole approach is devoid of focus. But, until teachers are made to realize the need of ICT, no amount of computerization can help. A question I often hear teachers who are unwilling to take the ICT plunge is, 'Can the student learn anything without the teacher explaining or intervening? And my answer to that is, 'Students also have ideas of their own and knowledge that they gathered from daily life; this knowledge and ideas are not accepted or utilized by teachers. Using ICT this can be achieved in a big way.' Teachers have to be trained to facilitate the learning process, make the process real, achievable, challenging, yet exciting and not intimidating. Reducing teacher talk and encouraging student discussion is extremely important. Everything need not be written on the blackboard to be considered as taught. Many teachers think the computer is used only to make the content look attractive! They need to know that in 21st century, information is not difficult access, instead organizing, sharing, and collaborating become essential skills. Hence, ICT is not merely to portray information but to interact, share, and thus learn. ICT provides meaningful, absorbing media that makes teaching-learning more productive.

According to Peeraer and Petergem[9], ICT benefits schools in several ways: (i) enhancing learning in classroom; (ii) improving school management and related tasks; (iii) improving accountability, efficiency and effectiveness in school activities; (iv) introducing usage of Power Point presentations and internet. Keengwe and Onchwari[10] support the view that ICT in schools can lead to high quality teaching and learning. Others who confirm to this view are Jhuree[11], Yusuf[12], Dzidonu[13], Higgins and Moseley[14], and Rebecca and Marshall[15]. Nisar, Munir and Shafqat[16] found that availability and usage of ICT improves the knowledge and learning skills of students. Hence, it compels policy formulation for the education sector. Literature reveals that when well-utilized, ICT in schools has the potential to improve the teaching-learning process in many ways. ICT is learner centric and hence brings about active involvement of students in the learning process. Students get motivated when learning activities are challenging, authentic, multi-sensorial and multi-disciplinary.

ICT is the convergence of computer, communication and content technologies. It has attracted the attention of academia, business, government and communities to use it for innovative profitable propositions. In order to compete in a global competitive environment, a highly skilled and educated workforce with aptitude and skill sets in application of ICT is inevitable for every nation. ICTs are a potentially powerful tool for extending educational opportunities, both formal and non-formal, to previously underserved scattered and rural populations, groups traditionally excluded from education due to cultural or social reasons such as ethnic minorities, girls and women, persons with disabilities, children with special needs and the elderly, as well as all others who for reasons of cost or because of time constraints are unable to enrol on campus. Use of ICT will catalyse the cause and achieve the goals of inclusive education in schools. There is no conclusive research to prove that student achievement is superior when using ICTs in the education space, either in the developed or in developing countries. However, there is a general consensus among practitioners and academicians that integration of ICTs in education has an overall positive impact on the learning environment. ICTs have the potential to innovate, accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change Lemke and Coughlin3, Davis and Tearle[4]. In diverse socio-economic and cultural contexts, ICTs can be successfully leveraged to reach out to a greater number of students, including those to whom education was previously not easily accessible, and help in promoting learning, along with exposing students to the technical skills required for many occupations. Other benefits of ICT in education are:

- It has the potential to improve education system of the nation
- It can transform the nature and quality of education as a whole
- It helps to enhance the quality of education by facilitating new forms of interaction between students, teachers, education employees and the community
- It acts as and provides students and teachers with new tools that enable improved learning and teaching and adds to skill formation
- It improves the learning process through the provision of more interactive educational materials that increase learner motivation and facilitate the easy acquisition of basic skills
- It makes education more accessible for all, bringing education to the doorstep of children living in remote rural locations by means of enabling distance learning
- It provides access to a vast treasure of educational resources and content for improving literacy

- It leads to integration of technologies with traditional educational activities although it can never replace the conventional teacher-student relationship that is so crucial to the development process
- It offers more challenging and engaging learning environment for students of all ages
- It enables a knowledge network for students
- It provides greater flexibility and individualized learning facilities to learners
- It enhances the overall teaching-learning process
- It avails high speed delivery of uniform quality content at reduced cost bringing the cost of education from very high to very low
- It can serve multiple teaching functions and diverse audiences
- It facilitates in enhancing the efficiency and effectiveness of educational administration and policy by improving the quality of administrative activities and processes
- Schools tend to witness a higher attendance, motivation levels, academic accomplishments and effective communication as an outcome of ICT programs and projects.
- Teachers too gain as a result of ICT initiatives. They find ICT to be useful for teaching as well as for personal and professional work. Application of ICT in teaching makes teaching more innovative, interesting, interactive, easy and effective. It complements the traditional teaching-learning process.
- While imparting knowledge with the aid of ICT educators find that students are more receptive and responsive. Also, ICT can help to impart more information and knowledge to students in a shorter time, enabling maximum utilization of resources and time.

ICT INITIATIVES IN INDIAN EDUCATION

Considering the immense importance of ICTs, the government of India has formulated the National Policy on ICT enabled school education which aims at preparing youth to participate creatively in the establishment, sustenance and growth of a knowledge society leading to all round socio-economic development of the nation and global competitiveness. In India, ICTs was launched in schools in December 2004 and revised in 2010 to provide opportunities to secondary stage students for building upon their capacity on ICT skills and direct them towards computer aided learning process. ICT in schools have been included under the Rashtriya Madhyamik Shiksha Abhiyan (RMSA) [17]. The scheme is a major catalyst to bridge the digital divide amongst students of various socio-economic and other geographical barriers. The scheme also provides support to States and Union Territories to establish computer labs on sustainable basis. Research shows that ICT plays

a leading role in promoting the economy of a country. The role of ICT is multidimensional. ICT is viewed as a "major tool for building knowledge societies"[18] and, particularly, as a mechanism at the school education level that could provide a way to rethink and redesign the educational systems and processes, thus leading to quality education for all. Although ICT infrastructure by itself may not contribute to a country's economy, it is believed that it does facilitate overall economic growth. ICT can strengthen the economy in specific sectors or in specific processes that lead to economic growth. However, ICT is simply a tool for achieving higher economic growth and not an end in itself. Academicians, industrialists and policy makers tend to accept a direct correlation between use of ICT and positive macroeconomic growth. ICT has a vital role in connecting the rural economy to the outside world for exchange of information, a basic necessity for economic development. Effective use of ICT can demolish geographical boundaries and can bring rural communities closer to global economic systems. There is no doubt in the near future's development will based on ICTs.

Nevertheless, technology is only a tool and the success of ICTs in enhancing the delivery of quality education to the needy, without widening the gap, will depend largely on policy level interventions that are directed toward how ICTs must be deployed in school education. In India, various ICTs have been employed over the years to promote primary and secondary education in schools. However, there have been enormous geographic and demographic disparities in their use. Some states and regions in the country currently have an enabling environment in place that allows for a greater use of ICT for education, whereas others lack such an environment. As per the 2011 census, nearly three-fourth of the Indian population lives in rural areas covering over 6 lakh villages. The state of rural education in India is though very poor. There are very few government schools in most villages while private schools are largely concentrated in the urban areas. Children have to travel far away distances to avail basic education facilities, not to mention the acquiring of ICT skill sets and facilities. In fact, majority schools in rural areas do not provide computer education at all. The National Policy on Education[19] provides for the scheme of ICT for all rural schools in India. Measures have also been taken to reduce and remove rural-urban disparities and promote diversified and better employment opportunities in rural areas. In the rural context, the main focus of NPE is the implementation of schemes and programs, such that predominantly address the educational needs of rural areas including technical education. ASER-2014[20] states that for six years now ever since the turn of the century, more than 96 percent of children (in the age group 6- 14 years) are enrolled in school in rural India. 71 percent of enrolled children are attending school during the winter days. With growing and visible progress from year to year, increasing figures of enrolment and attendance in rural schools, it becomes pertinent to focus on delivering quality ICT education to this section of

the population pie towards creating a learned and skilled human resource for furthering economic growth and development.

Information and Communication Technology (ICT) is a development strategy for developed as well as developing nations. It can bring out great social transformations through access to people and creating awareness. ICT can provide great opportunities to poor people by letting them access markets, health, and education. ICT is not related with only item like the internet, computer or telecommunications but it is a convergence of different electronic tools that facilitate the functions of information processing and communication, including transmission and display. ICT can be effectively used for educational development. The initiative of ICT Policy in School Education is inspired by the tremendous potential of ICT for enhancing outreach and improving quality of education. This policy endeavours to provide guidelines to assist the States in optimizing the use of ICT in school education within a national policy framework. The government of India has announced 2010-2020 as the decade of innovation with special focus on ICT enabled education and acquiring of ICT skills for students. The motive of the national policy on education is to create an environment of integrated development for education and economic empowerment of rural students. Important initiatives and strides have been taken in the sphere of rural education:

- Computer literacy projects for teachers and students
- Mobile classrooms through IT buses
- E-Learning centres and kiosks for enhancing online education for social and economic change in rural society
- Community Tele-centres to meet the needs of ICT learning outside formal school setting
- Bicycle-based connectivity in rural areas
- National award for teachers using ICT in schools in the teaching learning process
- Development of IT curriculum
- Innovative Rural Reach Program by Infosys for imparting first hand ICT knowledge to children of grades 5-10 in villages
- Higher education ICT initiatives such as E-Gyankosh, Gyan Darshan, Gyan Vani and various other distance education programs
- There is a need for public-private partnership for resource mobilization for funding ICT education in rural areas to provide need-based ICT Education in rural areas specific to their skill sets and to formulate policies to promote broad access to skills and competencies for learning and adopting ICT Provision of broad-based formal education of ICT

CHALLENGES IN IMPLEMENTATION OF ICT ENABLED EDUCATION

Although ICT has the potential to improve education system of a country to a great extent, yet it is not the case in the developing countries. There are multiple issues and challenges confronting the implementation of ICT education in schools and educational institutions in these countries and the problems are much more magnified in case of schools located in remote villages and rural areas. One of the main handicaps to develop the educational potential of ICT comes from the traditional culture of schools[21,22,23]. For rural schools in specific, the introduction of ICT faces hindrances in the form of internal and external barriers. Internal barriers to ICT implementation in schools in rural locations include:

- Lack of trained teachers is a major obstacle in the use of ICT in rural education is the lack of knowledge and skills. There is dearth of dynamic teachers formally trained in ICT. Moreover, there is hardly any quality training imparted on a regular basis to teachers involved in ICT education.
- Research studies[24,25,26,27,28] have reported a number of barriers/obstacles teachers experience in using ICT in their classrooms. These include lack of resource access, inadequate training opportunities, lack of confidence amongst among teachers, paucity of time, insufficient knowledge about integration of ICT in lessons, technical issues, poor administrative support and poor fit with the curriculum. Barriers must be first identified, and then only actions can be taken to overcome those[29].
- McCarney[30] reported that the inadequate number of computers, dearth of class time for students to use computers and insufficient free time for learning were the most significant barriers. Insufficient training and paucity of professional development programmes for integrating technology into the existing curriculum were also identified as major hindrances toward ICT integration in schools[31, 32]. Lack of class time was another factor that prevented teachers from using ICT in classrooms[33.] Wood et al.[34] showed that confidence with technology was linked to better computer integration in the classroom. They identified individual characteristics such as experience with computers and confidence with technology as reasons for why teachers do not use computers (in spite of the increased availability of hardware).
- Paucity of software, lack of funds, inadequate time and lack of technical skills were also found to be the major barriers to the usage of technology in most Jordanian schools[35].
- Unfavourable organizational culture and poor attitude and beliefs often in developing nations, the educational organizations and school management fail to perceive the importance and

seriousness of the role of ICT in education enhancement. Also, the teachers' attitudes and beliefs are outdated and orthodox. They are unaware and rigid and not willing to adapt to the change. They harbor false beliefs that ICT is meant primarily for the youngsters and are sceptical about the effectiveness and utility of ICTs in school education.

- Shortage of time in schools, teachers are usually burdened with multiple tasks other than teaching. Moreover, they have to teach all types of subjects along with ICT. They do not have time to design, develop and incorporate technology into teaching and learning. The teacher needs time to collaborate with other teachers as well as learn how to use hardware and software and at the same time keep oneself updated with the latest technology.
- Issues of maintenance and upgrading of ICT equipments in rural schools is subject to their limited financial resources. Largely, the government initiatives are restricted by budgetary constraints. The ICT projects in rural schools are not self-sustainable. When the projects launched by government or private sector phases out, the maintenance of equipments need to be borne by the students. The students often with weak economic backgrounds are unable to fund the maintenance and computing facilities expenses.
- A large proportion of the educational software produced in the world market is in English. Majority of online content is available in English. In developing countries, English language proficiency is not high, especially outside the urban areas which becomes a serious barrier to maximizing the educational benefits of ICT.
- Shortage of equipments that is lack of computers and computer-related resources such as printers, projectors, scanners, etc. in government schools in rural areas. The ratio of computer per student is insufficient. The option of private schools is very few or missing in these regions. There is a mismatch between the complementing resources and inappropriate combination of ICT resources result into reduced diffusion of technology as well as poor ICT understanding in these educational institutions.
- Even the basic ICT equipments and computers possessed by rural schools are unreliable and undependable. The schools lack up-to-date hardware and software availability. Old and obsolete equipments are major hindrances to ICT adoption and application.
- Lack of technical support in rural schools face issues related to technical know-how, absence of ICT service centres, shortage of trained technical personnel. Whether provided by in-school staff or external service providers, or both, technical support specialists are essential to the continued viability of ICT use in a given school. Without on-site technical support, much

time and money may be lost due to technical breakdowns. One of the major obstacles to optimizing computer use in schools has been the lack of timely technical support.

- Resource related issues and internet rural schools usually face trouble with respect to the availability of ICT related resources such as supporting infrastructure, uninterrupted electricity, supplementary resources like multimedia, projectors, scanners, smart boards, and so on. Despite being an integral component of the ICT, internet is lacking in most rural schools. Most schools cannot afford the high fees charged by internet providers and even where there is internet, slow or erratic connectivity destroys the very essence and impact of ICT.
- Other external factors inhibiting the usage of ICT in rural schools are social and cultural factors inherent to these regions, lack of initiative by community leaders, corruption and burglary.
- There is resistant from teachers, basically from older teachers as compared to younger ones, to apply ICT in their subject.. Hence teachers need to update their knowledge and skills as per change in the curriculum and technologies.
- Overall the school level barriers can be further classified into two categories: one related to school ICT infrastructure and other related to technical and administrative support provided by the school. It was evident from the literature that barriers to the use of ICT in secondary school include lack of motivation[36,37,38]; lack of confidence[39,40]; lack of funding[33,36,29]; lack of skilled personnel[39,21]; poor ICT infrastructure[39,21,41]; low connectivity[39,42]; lack of awareness[39,24] ; inadequate maintenance of hardware and software[39,40] and power interruptions[39] .

THE POSSIBLE SUGGESTIONS FOR BETTER IMPLEMENTATION OF ICT IN RURAL SCHOOLS OF INDIA

At present in India, ICT in school education is strictly limited to a handful of elite schools. Beyond that, it's just a computer lab that's held apart from the conventional educational process .Though computers came to Indian classrooms in the year 1984-85, the level of adoption of modern technology in the teaching and learning process has been limited and uneven. Various ICT tools must be available and it must be accessible at demand. Many schools have limited resources for buying books, stationery, furniture and other classroom materials. Role of private sector providing services in such sectors may be taken into account. Rural population may not be able to pay hefty amount to utilize such ICT resources for education. One of the great challenges for quality control in education

is lack of standards for parameters to measure the quality of education. For the solution of this all the accreditation bodies like NAAC[43], NBA[44], AICTE[45], CBSE[46] and other authorities must sit together and circulate a standard list of parameters to decide the quality of education.

India is developing as a knowledge economy and it cannot function without the support of ICT. The gap between demand and supply of education has necessitated the government and institutions to formulate policies for more beneficial use of ICT. In order to bridge the gap, it is necessary to evolve cooperation between public and private stakeholders. There is a need to focus on improving four aspects of ICT - access, usage, economic impact and social impact. The study makes the following suggestions for improving and enabling ICT education in rural India:

- The States will establish state of the art, appropriate, cost effective and adequate ICT and other enabling infrastructure in all secondary schools
- Based on the size of the school, needs of the ICT programme and time sharing possibilities, States will define an optimum ICT infrastructure in each school. Not more than two students will work at a computer access point at a given time. At least one printer, scanner, projector, digital camera, audio recorders and such other devices will be part of the infrastructure.
- Each school will be equipped with at least one computer laboratory with at least 10 networked computer access points to begin with. Each laboratory will have a maximum of 20 access points, accommodating 40 students at a time. The ratio of total number of access points to the population of the school will be regulated to ensure optimal access to all students and teachers.
- In composite schools, exclusive laboratories with appropriate hardware and software will be provided for the secondary as well as higher secondary classes.
- In addition, at least one classroom will be equipped with appropriate audio-visual facilities to support an ICT enabled teaching-learning.
- Appropriate hardware for Satellite terminals will be provided to selected schools in a progressive manner.
- Computer access points with internet connectivity will be provided at the library, teachers' common room and the school head's office to realise the proposed objectives of automated school management and professional development activities.
- ICT enabled education can be significantly enhanced and the range of classroom practices expanded with the introduction of digital devices like still and video cameras, music and audio devices, digital microscopes and telescopes, digital probes for investigation of various

physical parameters. These will also form a part of the infrastructure. States will make appropriate choices and promote the use of such devices in classrooms.

- All computers in the school will be part of a single local area network to enable optimum sharing of resources. In addition to the laboratory, internet connections will also be provided at the library, teachers' common room and the school head's office.
- Each school will be serviced with broadband connectivity capable of receiving streaming audio and video, a range of digital learning resources and interactive programmes. The number of computers given internet connectivity will be governed by the available bandwidth, in order to ensure adequate speeds. A mechanism to have offline access to internet content will be set.
- Teachers and students will be educated on issues related to the safe use of internet Firewalls and other security measures will be implemented to guard the school network against cyber attacks and misuse of the ICT facilities. Appropriate guidelines for network security will be developed.
- An EDUSAT[47] will be planned at each state with interactive terminals (SIT) and receive only terminals (ROT)
- A software environment favouring pedagogy of learning which promotes active learning, participatory and collaborative practices and sharing of knowledge is essential to nurture a creative society. Free and Open Source Software – operating system and software applications will be preferred in order to expand the range of learning, creation and sharing.
- A wide variety of software applications and tools, going well beyond an office suite is required to meet the demands of a broad based ICT literacy and ICT enabled teaching learning programme. Graphics and animation, desktop publishing, web designing, databases, and programming tools have the potential of increasing the range of skills and conceptual knowledge of the students and teachers. A judicious mix of software applications will be introduced in schools.
- Creation and widespread dissemination of software compilations, including specialised software for different subjects, simulations, virtual laboratories, modelling and problem solving applications will be encouraged. These will be distinct from multimedia packages and digital learning resources.
- Regular and regulated supply of electricity, appropriate electrical fixtures, adequate power backup and support, including alternate sources of energy, where needed, will be ensured. Students and teachers will also be trained in the safe use of electrical outlets and fittings.

- Physical facilities like an adequately large room, appropriate lighting and ventilation, durable and economic furniture suitable for optimisation of space and long hours of working will be established. Alternate layouts and arrangements facilitating interactions amongst students and with the teacher will be encouraged.
- Adequate safety precautions and rules for use will be established. Each laboratory will be equipped with a portable fire extinguisher and students and teachers trained in its use. An appropriate fire drill will also be implemented.
- Capacity building of teachers will be the key to the widespread infusion of ICT enabled practices in the school system. A phased programme of capacity building will be planned. In service training of teachers will comprise of Induction Training as well as Refresher Courses. The induction trainings will be imparted by the Regional Institutes of Education of the NCERT[48], SCERTs[49] or such other institutions of the Central and State Governments and will preferably be completed before the commencement of the academic year. The refresher trainings will be carried out every year to enable teachers to share, learn and keep abreast of the latest trends in ICT based teaching learning processes. The induction training will be followed by teacher's evaluation to ensure that the minimum competency is achieved.
- Beginning with an initial sensitisation through ICT operational skills and ICT enabled subject teaching skills, teachers will become part of online professional groups (e.g. English teachers association) to continue their education, pool in their resources and actively contribute to the strengthening of domain specific knowledge within the country. The forums will also facilitate continuous development of ICT skills introducing them to tools and resources in different subjects / specialisations as well as create and share learning resources in those subjects.
- School heads will play an important role in establishment and optimal utilisation of ICT and ICT enabled education practices in the school. All school heads will undergo appropriate orientation in ICT and ICT enabled education training programmes. This will also help them in building up digital resources for the school.
- School heads will also be trained in processes leading to automation of administration, management and monitoring of the school system and will play a proactive role in the implementation of School Education Management Information System(SEMIS)[50]
- States / Districts Education Department personnel at all levels will be oriented to infuse ICT into their work. They will also be oriented to various aspects related to the ICT implementation at the school level, SEMIS and sustenance of the ICT infrastructure.

- National and State level agencies, like the National Council of Educational Research and Training, the Central Institute of Educational Technology, the National Institute of Open Schooling, the State Councils of Educational Research and Training, the State Institutes of Educational Technology or any other public educational agency designated by the State will develop curriculum, resources, and undertake capacity building programmes, which will serve as models for adaptation and implementation across the system. These activities will not be outsourced.
- The States' Department of Education will spearhead an advisory group to guide the implementation of the ICT programme, its monitoring and evaluation. The advisory group will consist of the concerned Departments, a reputed engineering Institute of the State, University Departments, etc taking into consideration the variety of technical, educational, financial and administrative tasks involved. The States' Department of Education will synergise with the appropriate departments and state level agencies to ensure the establishment of connectivity and electricity in all schools. This will include negotiated norms for pricing, quality of service and maintenance.
- States will explore the possibilities of sharing the infrastructure partly or wholly with the community to extend education or train youth after school hours or similar purposes. Care will be taken to ensure that such usage does not compromise the school's educational or ICT programmes. The BOOT agency and/or the school may also utilise it for augmentation of resources. States will try out and establish appropriate community partnership models for optimum utilisation of infrastructure and resources, while ensuring safety of school property.
- Finally, Programme Monitoring and Evaluation Group (PMEG) [68] of the Department of School Education & Literacy, Ministry of HRD, Government of India, will be tasked with the overall responsibility of guiding the implementation of the ICT programme in schools across the country. The PMEG may set up task groups and invite institutions or established professionals with substantial expertise in that sector to develop norms, specifications, guidelines, evaluation reports, white papers etc. to guide the States in implementing the ICT programme.

CONCLUSION

The future roadmap of ICT-based education depends on a speed of broadband penetration, availability of web-enabled and mobile compatible learning content and maturity of consumers in accepting the digital format of education. As far as former is concerned, the Government seems to be moving speedily enough in creating the requisite infrastructure as soon as possible, whereas for the

latter, the consumers in urban areas have already undergone the initial phase of exposure to digital format of education and are now wiser to choose the right content to supplement the offline classroom based teaching learning. The big opportunity lies in rural areas wherein the digital format can bring in big gains. One major outcome of digital education would be increased collaboration between learners in all segments. Self-paced and on-demand learning would also gain further momentum in future. The study makes some significant suggestions for improving and enabling ICT education in India specifically the vast rural India. To make ICTs effective and integral tools of education, monitoring and evaluation must be a priority. The urban-rural divide in terms of access, equity, and resources will continue to be the main issues that Indian educators will have to address as the needs of the learning community will change on the priority basis.

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