Information and Communication Technology for Education in India and South Asia

Essay II

ICT in School Education (Primary and Secondary)

infoDev

PRICEWATERHOUSECOOPERS

Executive Summary

The essay on **use of ICTs in school education** provides a study of trends and dominant features of the use of ICTs for school education as profiled in different initiatives captured in the country reports. The essay highlights the spectrum of experiences from high-end technology solutions to low-end TV/radio-based initiatives that have been successful in different countries at the K12 level. The paper also examines the key issues and challenges in the effective implementation of ICTs in school education and provides suggestions to address these challenges and aid the implementation of ICTs in school education. An observation of international trends in application of ICTs in schools indicates that it is directly related to the development of schools and the teaching and learning environment. It is observed that new and emerging technologies are being integrated with the older technologies to make ICT applications in education more effective. Educators are also showing an increasing tendency to use mobile technology to enable access to education. There is a great deal of effort being expended around the world on the development of systems that will standardize the development of resources, catalog them, and store them. These include learning objects, which are digital Web-based resources created to support learning and can function as discrete entities or be linked in order to relate to explicit concepts or learning outcomes. Repositories are libraries where these digital resources are stored and provide teachers, students, and parents with information that is structured and organized to facilitate the finding and use of learning materials regardless of their source location.

ICT in School Education (Primary and Secondary)

The United Nations' Millennium Development Goals (MDGs) two and three are about achieving universal primary education and promoting gender equality, respectively. The MDGs in education are defined in terms of participation and completion of primary education by all children and the elimination of gender discrimination in education. Despite the continued efforts of the various Governments on universalizing the primary and elementary education, through a wide range of programmes and schemes, access to quality education continues to be an obstacle in the achievement of the education goals.

For instance, in India, during 2004 – 05, while the Gross Enrolment Ratio for children enrolling in classes I to VIII was 97 percent, the Drop-out Rate for the same classes was as high as 46 percent. The situation is more worrying at the secondary education level (classes IX and X), where the enrollment is recorded at 53 percent and the Drop-out Rate is as high as 60 percent[1]. Efforts so far have addressed to a considerable degree, the concerns of equity as well as that of regional parity, however concerns of quality have not received adequate attention. Recognizing this, the Government of India's flagship education programme at the primary level - the Sarva Shiksha Abhiyan (SSA) - has streamlined its focus on 'quality'. The situation is similar across the South Asia

[1] Selected Educational Statistics 2006 – 07; Government of India, Ministry of Human Resource Development, New Delhi

region. With the target timelines for universalizing of primary and secondary education nearing, there is a sense of urgency in accomplishing the goals set therein.

As is being increasingly articulated, if after spending large sums of money on programmes and schemes, countries have not become fully literate, it is time that innovative and cost effective methods be put in place to address the problem of education in these countries[2]. While this is a larger problem and points to the need for reform in the educational systems of these countries at various levels - pedagogical, curricular, as well as institutional, the emergence of various Information and Communication Technologies (ICTs) and their increasing acceptance and adoption by society provide unique opportunities and could potentially promote education on a large scale. While there is no conclusive research to prove that student achievement is higher when using ICTs in the education space, either in the developed or developing countries, there is a general consensus among practitioners and academics that integration of ICTs in education has a positive impact on the learning environment. It is understood that in diverse socio-economic and cultural contexts ICTs can be successfully employed 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.
ICTs act as and provide students and teachers with new tools that enable improved learning and teaching. Geographical distance no longer becomes an insurmountable obstacle to obtaining an education. It is no longer necessary for teachers and students to be physically in proximity, due to innovations of technologies such as teleconferencing and distance learning, which allow for synchronous learning.[3]

ICTs in schools provide an opportunity to teachers to transform their practices by providing them with improved educational content and more effective teaching and learning methods. ICTs improve the learning process through the provision of more interactive educational materials that increase learner motivation and facilitate the easy acquisition of basic skills. The use of various multimedia devices such as television, videos, and computer applications offers more challenging and engaging learning environment for students of all ages.[4] A study conducted by the International Institute for Communication and Development (IICD) indicated that 80 percent of its participants felt more aware and empowered by their exposure to ICT in education, and 60 percent stated that the process of teaching as well as learning were directly and positively affected by the use of ICT.[5]

Twenty-first century teaching learning skills underscore the need to shift from the traditional teacher-centered pedagogy to more learner-centered methods. Active and collaborative learning

[2] 'Using Technology for Education', Guilherme Vaz, IL & FS Educational Technology Services, Discussion Paper on National Policy on ICT in School Education

[3] Victoria L. Tinio, ICT in Education (New York: UNDP-APDIP, 2003).

[4] Wadi Haddad and Sonia Jurich, "ICT for Education: Potential and Potency," in Technologies for Education: Potentials, Parameters, and Prospects, eds. Wadi Haddad and A. Drexler (Washington, D.C.: Academy for Educational Development), 28-40.

[5] International Institute for Communication and Development, ICTs for Education: Impact and Lessons Learned from IICD Supported Activities (The Hague: IICD, 2007), http://www.iicd.org/files/icts-for-education.pdf (accessed March 14, 2009).

environments facilitated by ICT contribute to the creation of a knowledge-based student population. Education leadership, management, and governance can also be improved through ICT by enhancing educational content development and supporting administrative processes in schools and other educational establishments.[6]

ICT in School Education in the Developed World

In the developed countries, and the urban elites of advanced economies, twenty-first century education integrates technologies, engaging students in ways which were not previously possible, creating new learning and teaching possibilities, enhancing achievement and extending interactions with local and global communities. Students live in a world that has seen an information explosion and significant and rapid social and economic changes.

ICT in School Education in the Developing World

In the developing world, ICTs are used largely to increase access to and improve the relevance and quality of education. ICTs have demonstrated potential to increase the options, access, participation, and achievement for all students. The unprecedented speed and general availability of diverse and relevant information due to ICT, extends educational opportunities to the marginalized and vulnerable groups, among the other disadvantaged.

ICTs in the developing world have the potential to enhance the education experience for children who:

- live in rural and remote-rural locations
- have special learning needs
- have physical disabilities constraining their access to schools
- have dropped out and/or have kept themselves out of school for various reasons.
- aim for excellence and fail to get satisfied in the current system

Teachers and learners in the developing world are no longer solely dependent on physical media such as printed textbooks which are often times outdated. With today's technology, one even has the ability to access experts, professionals, and leaders in their fields of interest, around the world at any given time.[7]

In India, various ICTs have been employed over the years to promote primary and secondary education. These include radio, satellite based, one-way and interactive television, and the Internet. However, there have been enormous geographic and demographic disparities in their use. Some states in the country currently have an enabling environment in place that allows for a greater use

[6] Haddad and Jurich, "ICT for Education: Potential and Potency"
[7] Ibid

of ICTs for education, whereas other states lack such an environment making the use of ICTs for this purpose very sporadic.[8]

It is also important to keep in mind that ICTs in education are a potential double-edged sword—while ICTs offer educators, tools to extend education to hitherto inaccessible geographic regions, and to deprived children and empower teachers and students through information, there is also the danger that such technologies may further widen the gap between the educational *haves* and *have-nots*. However, 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.

The Governments in each of the countries in the South Asia region are now keen and committed on exploring the uses of ICTs for school education. Therefore, Government policies lately reflect their realization of the importance of integrating ICT use and the promotion of quality education enabled through ICTs. The creation of educational networks offer substantial economies of scale and scope, when attempting to improve the quality of education and seek to standardize quality across the system. Hence, Governments are investing in infrastructure facilities that link schools/educational institutions and resource centers.

However, despite administrators and experts alike recognizing the potential of ICT in improving access to quality education, the utilization of ICTs in school education in the South Asian countries is still not at a very advanced stage. The following table classifies countries in the Asia Pacific region based on their appreciation of ICTs and the availability of ICTs. It shows that while appreciation of ICTs is high in the South Asia region, their actual availability for utilization is low.

Countries	Appreciation of Technology	Availability of Technology
Afghanistan	Low	Low
Australia	High	High
Bangladesh	High	Low
Bhutan	High	Low
Cambodia	High	Low
China	High	Low
Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan)	High	No available data
Democratic People's Republic of Korea	High	No available data
India	High	Low
Indonesia	High	Low
Iran	High	No available data

[8] 'Promoting the Use of Information and Communication Technologies for Primary and Secondary Education: The Case of the States of Chhattisgarh, Jharkhand and Karnataka in India' Discussion Paper by Amitabh Dabla, Educational Development Centre, Bangalore India.

Countries	Appreciation of Technology	Availability of Technology
Japan	High	High
Malaysia	High	High
Maldives	High	Low
Mongolia	High	Low
Myanmar	High	Low
Nepal	High	Low
New Zealand	High	High
Pacific Islands Countries	High	Low
Lao PDR	High	Low
Republic of Korea	High	High
Sri Lanka	High	Low
Thailand	High	Low
Vietnam	High	Low

Source: Strategy Framework for Promoting ICT Literacy in the Asia–Pacific Region, UNESCO Bangkok Communication and Information Unit, 2008
http://www2.unescobkk.org/elib/publications/188/promotingICT_literacy.pdf

South Asia is yet to harness the potential of ICTs in creating, constructing, capturing, managing, and sharing information and knowledge. India is rated high on appreciation because it has gone beyond policies that merely recognize the strategic role of ICT for growth and development and is already institutionalizing concrete measures that support ICT initiatives. However, it has been rated low on availability of technology due to data reporting that access to computers is "limited," the cost of Internet connections is relatively high, ISPs are described as "limited," and the ratio of number of computers per student stated as "insufficient."[9] These observations point to the need to frame appropriate policies, build adequate infrastructure, and set aside adequate funds in order to support the deployment of ICTs in furthering the education levels of the country.

Although ICTs do offer many beneficial opportunities for education, they are no substitute for formal schooling. The role of technology is to support school education and not replace it, though the technology may play an appreciable part in meeting the needs of children who cannot go to a conventional school. Access to ICTs ensures enhancement of traditional or formal education systems, enabling them to adapt to the different learning and teaching needs of the societies.

ICTs in school education initiatives that focus on the following areas are most likely to successfully contribute to meeting the Millennium Development Goals[10]:

- Increasing access through distance learning

[9] Strategy Framework for Promoting ICT Literacy in the Asia Pacific Region, Elena E Pernia, UNESCO Bangkok Communication and Information Unit, Asia and Pacific Regional Bureau for Education, Thailand 2008.
[10] The World Bank.

ICTs can provide new and innovative means to bring educational opportunities to greater numbers of children of all ages, especially those who have historically been excluded, such as populations in rural and remote-rural areas, girl children facing social barriers, and children with disabilities and other compulsions. In almost all the developing countries of South Asia, distance learning has been an important component of the education policy of these nations. It is probably in this domain that traditional ICTs like radio, television, and audio cassettes were first deployed in the education space. In India, distance learning offered by institutions like National Institute of Open Learning (NIOS) and Indira Gandhi National Open University have used a combination of print and audio-visual material as well as traditional face-to-face interactions to deliver their content.

- Enabling a knowledge network for students

  With knowledge as the crucial input for productive processes within today's economy, the efficiency by which knowledge is acquired and applied determines economic success. Effective use of ICTs can contribute to the timely transmission of information and knowledge, thereby helping education systems meet this challenge.

- Training Teachers

  Large numbers of school teachers will be needed to meet the MDGs for education. The use of ICTs can help in training teachers to accomplish the targeted tasks on a mission mode. Moreover, ICTs provide opportunities to complement on the job training and continuing education for teachers in a more convenient and flexible manner. The use of ICTs for teacher training has been recognized by the governments of most South Asian countries and teacher training programmes like Intel Teach across India, Pakistan, and Sri Lanka; Microsoft Shiksha in India; and several other initiatives in Nepal and Bhutan are focused on using ICTs for training teachers. This includes training in applying ICTs in their teaching practices as well as using ICTs as a mode of delivery for these trainings.

- Broadening the availability of quality education materials

  Development of relevant, good quality content is perhaps the biggest challenge and opportunity in the educational technology space. While infrastructure, capacity building, monitoring, and evaluation are critical support structures without quality content, the learning experience of students will not be significantly improved by the mere presence of ICT. To that end content development is being focused on in many of the focus countries in our study. In India, several initiatives are ongoing for creating digital repositories and learning objects; the Sakshat Portal of Government of India, initiatives like National Program of Technology Enhanced Learning (NPTEL), the Multimedia Educational Resource for Learning & Online Teaching (MERLOT) seek to create quality digital content for different levels of education.

- Enhancing the efficiency and effectiveness of educational administration and policy

  New innovative technologies can help schools' improve the quality of administrative activities and processes. The Government of Afghanistan's articulation of the policy for ICT in education focuses on the need to provide access to ICT for all Ministry of Education administrative staffs, teachers, and students. The policy further envisages that through the use of information management systems, ICT will be extensively used to automate and mechanize work such as human resource management, financial management, monitoring and evaluation, the processing of student and teacher records, communication between government and schools, lesson planning, assessment and testing, financial management, and the maintenance of inventories. The Ministry of Education has developed GIS-based spatial data with detailed maps for better management of the education system in the country. More than 35 maps have been produced showing the location of schools all over Afghanistan, including the number of students and teachers by province.

The Government of Delhi, in India, has been a pioneer in using ICTs for better administration of the education system. The Department of Education, Government of Delhi, with 40,000 employees, 928 schools, and more than 120,000 students under its administrative jurisdiction has developed a comprehensive and functionally effective Web-based and GIS-based Management Information System (MIS). All the schools, zonal offices, district offices, regional offices, and various branches at the headquarters can share information using the Web-enabled software. Information for all stakeholders—students, teachers, and administrators—is available online through the Directorate's Web site (edudel.gov.in); this includes information on admissions, mark sheets, teacher attendance, transfers, pay slips, and so on.

International Trends in ICT in School Education

An observation of international trends in application of ICTs in schools indicates that it is directly related to the development of schools and the teaching and learning environment. For instance, changes to pedagogical practices in classrooms require that teachers should have access to infrastructure and are given the opportunity to develop the expertise to use the machines and software tools. The trends also indicate policy-makers, administrators, and teachers are using a variety of tools and strategies to improve access to learning opportunities, improve the teaching and learning experience for teachers and students, and make effective use of limited resources.

This section presents a select few international experiences that have been observed in ICT applications in primary and secondary education across the globe.[11]

Integrating New Technologies with Existing Technologies in Use

[11] A discussion on global trends in ICTs and Education in 2010 can also be found at the Education Technology Debate Forum of the World Bank http://edutechdebate.org/2010-ict4e-trends/10-global-trends-in-ict-and-education-for-2010-and-beyond/. It highlights trends like Mobile Learning, Cloud Computing, Gaming, Ubiquitous and Personalized Learning.

Older technologies such as print, radio, and television are more common in most part of the world, unlike the recent technologies such as Internet, e-mail, and wireless communications. This is largely due to the state of infrastructure development that had not allowed the adoption of newer technologies as extensive as the older technologies. In recent times, however, it has been noticed that these newer technologies are gaining prominence and are being integrated with the older technologies to make ICT applications in education more effective. Radio Sagarmatha in Nepal is one of the first community radios in South Asia. It is a radio-browse model wherein Internet is broadcast over the radio. It discusses public issues, conducts training for public radio journalism, and provides a venue for local ideas and culture. In 2000, the station added a weekly 25-minute Internet radio programme featuring local and international ICT-related news, and ICT glossary, radio web browsing, and interviews with relevant ICT resource persons. This program has been successful among the rural areas of Nepal.

Increased Use of Mobile Technology

In the developing countries of South Asia given the almost ubiquitous presence of mobile phones in some geographies, there is an increasing interest in the opportunities offered by this technology. Several initiatives using mobile phones for English language learning, for facilitating educational administration tasks, and other support informational and educational services are being widely offered.

In India, Bharat Sanchar Nigam Limited (BSNL), one of the largest telecom service providers with the widest reach in the country has launched "Learn English," a spoken English mobile learning program. The program aims to teach spoken English through common everyday stories and situations that are familiar to most people. It is currently available in nine regional languages for two levels, namely basic and advanced. The service can be subscribed to at a nominal cost of Rs. 20 per month and a call browsing charge of 30 paise per minute.

Other service providers have also entered the arena. IL&FS Education & Technology Services Limited (IL&FS Education) in collaboration with Tata Indicom have launched an "English Seekho" Program, which uses the mobile phone to teach English through simple 5 minute lessons that can be accessed at the learner's convenience. Another common usage of mobile phones is also found in support services for education, such as providing alerts and retrieving and sending EMIS reports. The Virtual University in Pakistan makes use of SMS to provide updates to students, schedule appointments, and so on.

However, as articulated by educationists and experts, the small screen size, limitations on the amount of data exchanged, and so on are problems that limit the usage of mobile phones (the models most commonly available) in actual content delivery in education.[12]

Content Development through Learning Objects and Repositories

[12] For a debate on the use of Mobile Phones vs PCs in Education refer to Edutech Debate at http://edutechdebate.org/mobile-phones-and-computers/

Learning technologies have been evolving over the last many years, starting from early mainframe-based programmed learning systems, microcomputer software packages, bulletin boards, CBT systems, authoring systems, and more recently after the Internet explosion, Web-based systems and Learning Management Systems. Development of content has largely been done on an individual basis, resulting in a scenario where the content software is not compatible with the latest technology. Moreover, there is no established system for cataloging and classifying virtual learning materials, leading to many excellent online learning materials remaining underutilized.

This scenario calls for the need for a standardized system for cataloging, storing, and retrieving content in ways that enable users to access and organize resources for their particular purposes as well as sharing it institutionally, nationally, and internationally. There is a great deal of effort being expended around the world on the development of such systems—ones that will standardize the development of resources, catalog them (metadata) and store them. Learning objects are digital assets that can be as diverse as a chapter in a book, a piece of text, a video or audio clip, or visuals on an overhead transparency or PowerPoint slide, and can be used in a variety of teaching settings, by course designers, managers, trainers, content writers, and learners.[13]

Learning objects can be identified, tracked, referenced, used, and reused for a variety of learning purposes. They are developed to function as discrete entities or to be linked in order to relate to explicit concepts or learning outcomes. Content requirements are determined through communication with educators across the target audience and then the learning object is developed by independent contractors. Learning objects may be self-contained, reusable, and capable of being aggregated.

Repositories may be described as libraries where learning object databases are stored and provide teachers, students, and parents with information that is structured and organized to facilitate the finding and use of learning materials regardless of their source location. Most repositories contain a Web-based user interface, a search mechanism, and a means of retrieving a learning object. While the initial leadership for learning object repositories has tended to come from the university sector, the interest and activity in the school sector is increasing rapidly.

[13] 'An Overview of Developments and Trends in the Application of Information and Communication Technologies in Education'; Glen M Farrell, Commonwealth of Learning; UNESCO Meta-survey on the Use of Technologies in Education, October 2003.

Open Learning Exchange, Nepal: E Pustakalaya and E Paath

OLE Nepal is engaged in creating content at two levels. The E Paath consists of interactive learning modules, mapped to the topics in the curriculum as prescribed by the Curriculum Development Centre (CDC) of Nepal. Subject matter experts work closely with the OLE Nepal developers to create these interactive learning activities. This easy to use software, rich in multimedia elements including text, audio, video, and animations is then used by teachers and students to understand concepts as prescribed in the curriculum. The content contains lessons, exercises, as well as assessment tools to enable teachers to effectively teach and evaluate students.

E-Pustakalaya is an electronic library which is a repository of reference material for the students, consisting of full text documents, images audio, video clips and software that are relevant for students. E Pustakalaya deploys a simple child friendly user interface that allows children to navigate, search, and link different documents including reference materials, course-related content, magazine, and newspaper content. Students can download the content as well as read it online. The repository is also accessible on the Internet to other users at http://www.pustakalaya.org.
Content creation in the E Pustakalaya is an ongoing activity and OLE Nepal has collaborated with several national and international organizations to source materials, these include Room to Read, Rato Bangala Foundation, Madan Puraskar Library, Save the Children, World Education, E-Learning for Kids and Azim Premji Foundation. OLE Nepal continues to work with other organizations to supplement this database. (*www.olenepal.org/)*

eGyankosh, Indira Gandhi National Open University (IGNOU), India

eGyanKosh, developed by IGNOU and launched in 2008, is a National Digital Repository created to store, index, preserve, distribute and share the digital learning resources developed by Open and Distance Learning Institutions in India. The repository contains all course material of IGNOU in print and video format and allows users to download this material free of cost once they have registered themselves. (*www.egyankosh.ac.in/)*

As learning repositories are developed, there emerged a need for international standards for these repositories, with the aim of achieving interoperability among various learning repositories. The development of easily accessible and sharable learning repositories is perhaps the most significant trend of all because of the potential it holds for reducing one of the largest single costs in the use of ICT in education—the cost of developing content. This development offers not only the economy and flexibility that comes with reusability but also allows content to be developed independently from the form of its delivery. It offers benefits across the spectrum of learning venues, from the remote learner in some form of distance education, to the teacher and learners face-to-face in a classroom.

Teachers and Online Learning Activities

ICT is an important source, which teachers may use to keep themselves abreast of emerging issues, share knowledge, and reach out to students. Several portals are being developed where teachers can network and share information including best practices. In India, the Sakshat portal developed by the Government of India provides teachers an opportunity to connect with each other and share experiences. The Teachers of India, an online portal developed by the Azim Premji Foundation and the National Knowledge Commission, was created with the objective of providing a forum for teachers to freely interact with each other across languages, facilitate the sharing of insights and best practices of teachers across the country and provide access to resources, information, and new experiments in education from all over the world in all Indian languages.

Key Issues and Concerns

There are many challenges in implementing ICTs effectively in existing schools. Policy-makers need to give ICTs adequate priority and attention so as to reap the benefits of deploying ICTs in school education. Students from rural locations or impoverished communities often tend to slip under the radar so that they do not have even basic access to ICT. Given that a number of schools still do not even have appropriate classrooms, computers, telecommunication facilities and Internet services, ICT continues to be a distant dream. The existing shortage of quality teachers further compounds the problem.

In developing countries, budgetary allocations for deploying ICTs in school education are typically limited, and given the high initial costs of setting up ICT systems, the cost factor works as a further deterrent. Shifting the existing focus from traditional educational models to an ICT-based education system is bound to be met with constraints and roadblocks. Some key issues and concerns that need to be addressed in order to create an ICT friendly environment in schools, especially in countries in the South Asian region, are identified later.

Availability of Infrastructure to Support ICT

A country's educational technology infrastructure sits on top of the national telecommunications and information technology infrastructure. Availability of adequate infrastructure to support the deployment of ICTs in schools is a tremendous challenge that schools in the region currently face. Apart from the high initial cost of purchasing and setting up the requisite infrastructure, the maintenance and upgrade costs, as well as the cost and effort of supporting such infrastructure are also roadblocks to the successful usage of ICTs in schools, especially in poor and remote areas.

Before any ICT-based programme is launched, policy-makers and planners must carefully consider the following:

- In the first place, a basic requirement is whether appropriate rooms or buildings available to house the technology? In countries where there are many old school buildings, extensive retrofitting to ensure proper electrical wiring, heating/cooling and ventilation, and safety and security would be needed.

- Another basic requirement is the availability of electricity and telephony. In countries within this South Asian region, large areas are still without a reliable supply of electricity and the nearest telephones are miles away. Power situation in rural and remote-rural areas even in some advanced countries in this region is undependable, and this affects the functioning of any ICT initiative. Power cuts with different power cut schedules each week play havoc with the timetables. Power outages and fluctuations add to the high maintenance costs of computer hardware.
- Policy-makers should also look at the ubiquity of different types of ICT in the country in general, and in the educational system (at all levels) in particular. For instance, a basic requirement for computer-based or online learning is access to computers in schools, communities, and households, as well as affordable Internet service.
- Insufficient access to computers is one of the main obstacles to the spread of ICT usage in school education. This is more so in the case of rural areas where the school is often the only access point for computers. Moreover, system software is expensive and prone to upgrades and requires resources put aside for new versions and upgrades. Operating System (OS) itself adds to the cost burden of the hardware. Although this will require massive investments in the infrastructure, it is nevertheless essential in order to guarantee equal access and to overcome the digital divide.[14] Strong, sustainable partnerships between the Government, private sector and civil society must be built to offset costs and mitigate the complexities of the integration of ICT in education systems (*refer Annexure II for details on Public-Private Partnerships [PPPs]*).

Availability of Funds to Implement ICTs

Given the current budgetary and resource constraints of various Governments, a widespread investment in ICTs in education is probably not possible in most developing countries. It is, therefore, critically important to better understand the cost-benefit equation of the wide range of ICT options and uses in order to effectively target-spend the scarce resources.

Economies of scale are achievable in distance education, although such Programmes typically require large up-front investments. Some of these costs may be shifted from the public sector to the individual users, but this in itself raises significant equity and access issues.

Capacity Building of Teachers

In most of schools in the subcontinent, the teachers are overloaded, less motivated and inadequately trained, and often deal with inconvenient working conditions. The use of ICTs in the classroom or in distance education does not diminish the role of the teacher; neither does it automatically change teaching practices. In such an atmosphere, building the capacity of teachers so that they are equipped to deal with using ICTs in classrooms is a challenge.

Resistance to Change

[14] International Institute for Communication and Development, ICTs for Education: Impact and Lessons Learned from IICD-Supported Activities.

Resistance is commonly witnessed while attempting to introduce ICTs into schools, very often from the teachers themselves, since they may be of the opinion that they shall become redundant once technology comes in or due to their perception that it is too late for them to adapt to a new environment. Educators themselves may be skeptical about the effectiveness of using ICTs in school education.

Lack of Awareness

There is a general lack of awareness about the utility of ICTs in education, as well as about the ICTs at our disposal and how they can be accessed and utilized economically and effectively. This lack of awareness and knowledge about ICTs and their use in education, even on the part of policy makers, administrators and educators, makes it particularly difficult to deploy ICTs in the field of school education.

Another critical issue with the usage of ICT in schools is the implementation of new technologies without having analyzed their appropriateness, applicability and impact on various environments and contexts. In most countries, particularly the least developed ones, they must learn from the experiences of others, but must also use technology to respond to their own needs and not just follow trends.[15]

Internet Usage

While the Internet contains tremendous potential for education, as described in the sections earlier, it also has its own pitfalls. For one, providing all the students with Internet access is a very expensive proposition for most Government schools. This is more so in the case of rural centers and remote areas, where Internet connections are bound to be erratic, if available at all.

A different challenge altogether when it comes to Internet usage is the effort involved in monitoring the students usage of the Internet to ensure that they do not visit educationally irrelevant and socially undesirable sites, thus detracting from the intended objective.

Language Barriers

English is the dominant language of the Internet. An estimated 80 percent of online content is in English. A large proportion of the educational software produced in the world market is in English. For developing countries in the South Asian region where English language proficiency is not high, especially outside metropolitan areas, this represents a serious barrier to maximizing the educational benefits of the World Wide Web.

Monitoring and evaluation

Many of the issues and challenges associated with ICTs in education initiatives are known by policy-makers, donor staff, and educators. However, data on the nature and complexity of these issues remains limited because of the lack of good monitoring and evaluation tools and processes. Where evaluation data is available much of the work is seen to suffer from important biases. Another

[15] Patti Swarts, "Main Issues, Possible Solutions and Opportunities for ICTs," Global e-Schools and Community Initiatives, http://www.gesci.org

problem in this area is the lack of a common set of indicators for ICTs in education. And, where data has been collected, it is often quantitative data related to infrastructure (number of computers, for example) rather than data that can help policy-makers gauge the impact of ICT interventions on student learning. [16]

If ICTs are to become effective and integral tools in education, and if accountability is to be demonstrated to donors and stakeholders, monitoring and evaluation must be a priority area of focus (*refer Annexure I for details on Monitoring & Evaluation*).

Key Learnings

Although there is great opportunity for improvement in school education at many levels through the use of ICTs, the road to achieving it is not easy. It will take continued commitment from all stakeholders involved to make any kind of substantial and sustainable change. The following broad-based suggestions may act as a basis for building a long-term roadmap to bringing ICTs to schools, and students at large in the South Asia region. A key to succeed in this endeavor is to adopt a comprehensive, end-to-end, systematic approach, with a phased and learn-as-you-go strategy for implementation, that can be adjusted to adapt to the specific needs and a changing environment.

Government Support

Government cooperation is necessary for ICT programmes to have substantial impact and be sustainable. In the attempt to reevaluate the education delivery system and curriculum of countries to include ICT, Governments have to consider the social context in which they are implementing this new phenomenon. The realities of individual countries and the disparities within and across their geographies, including their limitations say, the language barrier, should be considered and the availability of ICT should be made according to the needs and desires of the countries in order to facilitate appropriate learning and local ownership of knowledge.[17]

As discussed in the essay on policy coherence, governments need to adopt a coherent national policy framework, an effective ICT for education ecosystem, not just within the education field but also encompassing other complementing and enabling domains, which could ensure a child's overall development and the Country's larger objectives. Government policies must demonstrate political will and champion the integration of ICT purposes and be in line with national development goals and frameworks. In countries where implementation capacity is weak and misuse of resources can be a major problem, ICT can further enable the country to enhance its capacity building efforts and reduce the opportunity for corruption.[18]

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[16] Trucano, Michael. 2005. Knowledge Maps: ICT in Education. Washington, DC: infoDev/World Bank. Available at: https://www.infodev.org/en/Publications.8.html

[17] K. Toure, M.L. Diarra, T. Karsenti, and S. Tchameni-Ngamo, "Reflections on Cultural Imperialism and Pedagogical Possibilities Emerging from Youth Encounters with Internet in Africa" in ICT and Changing Mindsets in Education, eds. K. Toure, T.M.S. Tchombe, and T. Karsenti (Bamako, Mali: ERNWACA, 2008).

[18] Muwanga, "High Cost of Internet Connectivity in Africa: How Do We Achieve Mobile Telephony Success Story?"

Not only are national policies necessary but the Government also should assist in building organizational and institutional capacity to effectively deal with the complexities of integrating and implementing ICT in school education. Ministries of Education need to reconsider how they institutionalize positions of responsibility for ICT. The ICT unit's roles relate directly to improvement of teaching and learning using ICT, and the mix of skills required differs substantially from that of a traditional IT unit, providing infrastructural systems support. Therefore, appropriate considerations have to be taken to establish the right kind of institutions and positions to take the mission forward.

In the longer term, the active participation of the Government is essential to ensure the sector-wide introduction of ICT4E. Government involvement is critical to source additional investments in the ICT infrastructure, to integrate ICT in the curriculum, and to facilitate the widespread diffusion of materials.[19]

Creating Community-Based ICT Facilities

In 1999, the Bangladesh Rural Advancement Committee (BRAC) undertook an initiative to improve rural communities' access to ICT facilities. This involved selecting 800 *Gonokendros* (multipurpose learning centers) and equipping them with computers so that rural communities become familiar with usage of ICT and have access to a wide range of reading materials and resources, educational and non-educational.

The concept of community-based ICT facilities may be expanded at the school level to increase school students' access to ICT-based materials. For example, one ICT centre may be created for every five schools in the village/block, and this centre may be equipped with computers, television, radio, or other technologies. A timetable may be allocated so that each school has access to the ICT centre for one day of the week. Within each school again, different classes may be allocated different periods for accessing the ICT centre.

The challenges with implementing such a scheme, is that the distance of the centre from the various schools that warrant the need for firming up the mode of students' mobility and the frequency of such mobility to access the ICT facility and others. Moreover, the cost of renting or buying land and a building for setting up the ICT centre is another deterrent. However, this concept of school communities using common ICT facilities is a feasible way in which to introduce students from rural communities to ICTs.

Prioritizing and Planning Access to Remote Areas

Special consideration should be given to ICT connectivity and accessibility for educational purposes. Bandwidth and spectrum of radio and television wavelengths should be allocated for education. Planning for connectivity infrastructure and regulations should promote and facilitate educational use of ICT. The trends toward convergence and new mobile platforms for Internet-

[19] International Institute for Communication and Development, ICTs for Education: Impact and Lessons Learned from IICD-Supported Activities.

connectivity need to be fully exploited through innovative policies and partnerships that can help lower cost and expand access.

Regional networks of collaboration among countries where language and cultural context are similar could serve as a platform to promote educational quality and equality in an effort to bridge the digital divide. Greater exchange and collaboration in the production and management of educational resources would lower expenses in the development of materials as well as increase the amount of educational content available to teachers and students across the region.[20]

Adopting ICTs Suited to the Context

Given that Internet access is a problem for most schools, especially in rural areas, educators and administrators needs to consider the possibility of establishing Local Area Networks (LANs) in schools. Content could be hosted on school LANs, instead of trying to make them available on the Internet. A digital library on a server on the LAN would be a valuable asset, as it can store all types of digital content. Interactive multimedia material can also be hosted on the LAN at a much lower cost than on the Internet. This also has the added advantage of enabling students to access Programmes at their convenience, instead of having to adhere to a scheduled telecast.

Given that India has invested significantly in educational television and already has a commendable satellite television infrastructure, schools should focus on leveraging this technology. Some Indian educational channels are planning to switch to DTH soon, and it is very practical for them to do this. Due to the rapid fall in the cost of servers and storage, it is possible to record thousands of hours of TV programmes in digital form onto a server and make it available on demand from every PC on the LAN.[21]

Focus on Capacity Building

The use of ICTs in education calls for a fundamental shift in the way content is designed and delivered, as well as for teamwork and collaborative practices. New technologies cannot be imposed without enabling teachers and learners to understand these fundamental shifts. Ongoing training is necessary for the trainers in institutions and organizations who are engaged in the design of curriculum, teaching materials, and delivery of ICT-enabled education. At the same time, middle-level managers, both in the public service and the NGO sector, need to understand the pedagogy of learning through ICT and the management models that are required.

Given that teachers themselves are not comfortable using ICTs for teaching purposes, it is critical that there is a focus on capacity building of teachers so that they are equipped adequately to use ICTs in the classrooms. A locally-accessible instructor/trainer may be hired to provide training to the teachers on the usage of computers and Internet, and other ICTs that are proposed to be used in

[20] 'Information and Communication Technologies (ICT) in Education for Development', Global Alliance for ICT and Development, White Paper July 2009.
[21] Srinivasan Ramani, International Institute for Information Technology, Bangalore, e-Discussion with Community of Practitioners at UN Solution Exchange (Communities of Education and ICT for Development).

the school. Further, the contracts of procurement of ICT products could include among other, a short-term handholding feature with respect to familiarization and effective usage of the facilities.

It is also suggested that the Teachers Training Institutes (TTIs) shall ensure ICT-based teaching and learning methodologies be integrated into the educational streams and build capabilities to the next-generation teachers with the capacity to handle ICT facilities with ease.

Support of school administrators and, in some cases, the community, is critical if ICTs are to be used effectively. In addition, teachers must have adequate access to functioning computers (or other technologies) and sufficient technical support. Shifting pedagogies, redesigning curriculum and assessment tools, and providing more autonomy to local schools all contribute to the optimal use of ICTs in education.

Creative Solutions to Computer Shortages

Computer-based ICT interventions require significant investment in hardware. In addition, the expected active life of a computer is about 5 years, and as the hardware industry develops more sophisticated products, the software adapts to the top-of-the-line products. Computer recycling is an ecologically sound alternative to this problem. A growing number of not-for-profit organizations are dedicated to the tasks of collecting, refurbishing, and finding new homes for old computers.[22] In most South Asian countries, it has been found that computer usage is most cost effective when placed in common areas such as cyber cafes, community resource centers, and so on.

Alternative Power Sources

Given the situation of power shortages in rural areas, and the effect of power shortage on the usage of computers and other technologies in schools, the Governments should actively promote the usage of alternate sources of power. This ecologically friendly solution will also ensure a steady power supply to schools in rural areas. For example, the Bangladesh National ICT Policy 2009 highlights the imperative of providing access to ICTs to all schools and using alternate sources of energy such as solar panels if required.

Financing ICT Investments

Financing mechanisms for ICTs in education initiatives are quite varied. Due to the high up-front costs and large recurrent costs, countries and communities typically employ varied models of financing and cost recovery mechanisms. Public-private partnerships and user fees are important components of financing ICTs in education in many countries, although more research is needed to determine the impact and effectiveness of these mechanisms (*refer Annexure II for details on Public-Private Partnerships [PPPs]*).

[22] Wadi D. Haddad and Sonia Jurich 'ICT for Education: Prerequisites and Constraints', 'Technologies for Education: Potentials, Parameters and Prospects' UNESCO and AED 2002.

Conclusion

A carefully thought-out, integrated approach to introducing computers and the Internet into learning environments in developing countries can have a significant impact on teaching and learning. In countries where learning resources are limited and teachers never dream of having a fully stocked library, let alone the Internet, teachers and students have been introduced to a new world of learning. As a result, those with access to ICTs have been greatly empowered, and now believe they can compete in a global knowledge-based economy because they know that their knowledge, ideas, culture, and passions are as valuable as any in the world.

In order to more effectively prepare students to participate in ICT-driven education, greater commitments and willingness to share and adopt innovative solutions are needed from all aspects of society—from Governments, the private sector, communities, donors, parents, and students. Schools should be transformed into active learning environments open to their communities; telecommunication and power infrastructure policies should focus on schools as starting points for rural transformation; teachers and students must be empowered to be creative agents for change in their schools; and leaders must embrace a vision that will prepare their youth for tomorrow's challenges.[23]

Despite the challenges outlined in the paper, ICTs are being increasingly used in education in both the developed and developing world, in order to reach out to children from poor and remote communities, provide them with a quality education, and in general equip both teachers and students with a wider range of educational resource and enable them with greater flexibility. However, the growth and success of ICTs in education depends on the extent to which the issues and challenges outlined in this paper are addressed.

There is a critical need to document every effort for the benefit of the various stakeholders—decision-makers, institutions, NGOs and civil society. It is necessary to know what works and what does not, and what the implications are for policy making, planning, and implementation. Specifically, it needs to be understood that any new technology comes not merely with hardware and software, but with a learning and teaching style and grammar of its own, and that management practices need to be adapted in order to use the technologies effectively.

ICTs are, ultimately, only physical tools, which by themselves cannot bring benefits to students, teachers and communities at large. Therefore the unique contextual realities of this region, including, primarily, the initiative and impetus of the various countries and its constituents, the involvement of private companies and NGOs, and the level of infrastructure, play determining roles in creating enabling environments promoting the use of ICTs for primary and secondary education.

[23] Robert J Hawkins 'Ten Lessons for ICT and Education in the Developing World', World Links for Development Program, The World Bank Institute.

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- New Technologies for Literacy and Adult Education: A Global Perspective http://ncal.literacy.upenn.edu/products/wagner_kozma.pdf

Annexure I

Monitoring and Evaluation in ICT

The use of ICTs for school education as a result of the various programmes and projects implemented in the South Asia region has had an impact on educational access and quality, yet there are major issues pertaining to the measurement of these indicators. Monitoring and evaluation of learning gains, teaching practices, classroom environments, students' participation, and other activities are required and necessary for addressing ICTs-enabled educational quality and access. However, one of the major hurdles in assessing these indicators was that the majority of the programmes and projects implemented did not have adequate quantitative or qualitative monitoring or evaluation activities. Further even if any monitoring and evaluation activities were conducted they did not adequately measure indicators pertaining to ICTs enabled educational quality and access.

Monitoring and evaluating of programmes and projects are critical to ensure projects achieve their intended impacts and become sustainable in the long run. Appropriate indicators must be identified for every ICT project that can be monitored in order to effectively track progress. Stakeholders at all levels must be part of this process to ensure transparency and to avoid potentially corruptive practices throughout the projects.

Together with Aptivate, a UK-based NGO providing IT services for international development, Camfed, a NGO improving girls' education in Zimbabwe, Zambia, Ghana and Tanzania, has tested the efficiency and quality of personal digital assistants (PDAs) as a tool for monitoring and evaluation. This method is extremely time efficient. Data can be calculated within hours rather than weeks and through its ability to connect to the Internet it can be transmitted directly from the worker in the field to the headquarter.[24]

Supply-side based development models which are based on centralized designs and make "top down" assumptions of people ("teachers are resistant to change" or "lethargy of management") have been tried several times and have not been found to be successful. Hence, a "monitoring and evaluation" theme that does not situate itself on the needs for professional development of the teacher, based on principles of autonomy, an agency can end up emphasizing centralized databases that seek to "control" teachers work based on quantitative assessments of children performance, which can be counterproductive to meaningful education.[25]

This is not to deny the importance of "infrastructure" or "content" or "capacity building," except to state that these perspectives appear to reflect an dominant "ICTD" kind of thinking which is mostly "supply based." "We have ICTs so let us see what we can do with them" such

[24] 'Information and Communication Technologies (ICT) in Education for Development', Global Alliance for ICT and Development, White Paper July 2009.
[25] Gurumurthy Kasinathathan, IT for Change, Bangalore, Solution Exchange for the ICT for Development Community, 31 July 2008.

approaches do not proceed from the identifications of the objectives to be met, or critical challenges to be faced, from the respective domain's perspective. They seek to thrust some overarching technological world views on development domains whose enormous contexts and complexities, challenges, and goals are not given the prime positions as drivers of the policy.

Some suggested evaluating parameters that may be applied to monitor the effective implementation of the policy on ICT in school education are as follows[26]:

- Are the ICT-based methodologies in sync with the existing traditional teaching?
- Does ICT facilitate the teacher in teaching better?
- Does ICT help in explaining abstract concepts?
- Does ICT make learning more exciting?
- Does ICT prod the student to know more, beyond the classroom?
- Does ICT make the student understand better and recall lessons taught during his absence or in manner alien to him or her?
- Does ICT make learning more participative and encourage group learning?
- Does ICT support interaction?
- Does ICT ensure continued progress through enhanced learning?
- Is the ICT-based solution a textbook page turner and contains too much of textual content?
- Is there an excess on animations and cartoons?
- Are the animations too trivial or too complicated?

Annexure II

Public-Private Partnership in ICT

Collaborative initiatives in the manner of PPP, to promote ICT for education may be most relevant at the implementation level, where select key roles and responsibilities may be outsourced in order to make them more viable and efficient. However, one needs to be vigilant about partner-institutions, which may have direct business interest in the value chain while the outsourced role on which they are inducted might enable performance of roles that may conflict the overall interest and purpose of the initiative. Moreover, there is also skepticism about the degree to which the ability of such partnerships under PPP arrangements will work to reach interior rural areas and conduct operations on the scale required.[27]

If the Ministry of Education has to solely take on this task of equipping the schools with ICT facilities, it would be an enormous task and will require funds in large sums. Therefore,

[26] M.V. Ananthakrishnan, Developmental Informatics Lab, KreSIT, IIT Bombay, Mumbai, Solution Exchange for the ICT for Development Community, 31 July 2008.
[27] Binay Pattanayak, National Technical Support Group, Sarva Shiksha Abhiyan (SSA), New Delhi, Solution Exchange for the ICT for Development Community, 31 July 2008.

Governments will invariably need to form appropriate strategic partnerships in order to succeed in this endeavor of implementing ICT in schools.

The most common type of agreement is "seeding fund" partnerships with emphasis on front-end costs and mostly capital costs. However, such an approach tends to underestimate the total cost of ownership (TCO) of computers and other ICT equipment, which includes recurrent costs such as ongoing hardware maintenance and upgrades of hardware and software in addition to initial capital outlays. Also, teachers have to devote additional time and effort to learning new skills in content development, approaches to teaching, and methods of assessment.

An important aspect of private sector participation involves contributions "in-kind" of networking equipment, PCs, and concessional access to software licenses for an initial period, as well as ICT skills training for teachers and students. For example, Microsoft has partnered with many states throughout India to provide free basic technology training to teachers of state-funded schools. This includes "The Innovative Teachers Forums" that encourage innovative teachers to adopt ICT, award best practices in ICT integration, and support teachers in building global communities of practice (see "Microsoft Innovative Schools Program").

International agencies such as the Asian Development Bank and the World Bank have also invested in providing ICT to the basic education subsector. Some of these initiatives have involved setting up computer labs in schools, computerizing education administration through EMIS, and developing an e-curriculum with appropriate learning materials. Other initiatives have set up "school nets" and school-based telecentre projects where school children use the ICT facility during school hours and the community uses the facility for a fee after hours to generate an income that can help offset the centre's operating costs. Most of these are initially partnerships between the government and donor agencies but with the expectation that the community will take over the responsibility of ensuring sustainability once donor support ends. However, as mentioned, the transition has been difficult for many projects particularly in low-income communities.

India presents a wide range of success stories across various sectors, on effective partnership between the public and private sectors. Further, many of the Indian states have witnessed implementation of a variation of the CLCs through partnerships with private sector computer training companies.

The SSA has also undertaken a few initiatives to strengthen Computer-Aided Learning (CAL) in collaboration with a number of private organizations, since ICTs are accepted as capable of aiding the SSA in achieving its educational goals. Under the SSA framework, a provision has been made for computer education, which amounts to Rs. 1 crore (Rs. 50 lakhs for infrastructure) per district per year, and is made available to each State under CAL interventions. Under this programme PPPs are encouraged.

The State Government of Karnataka, for instance, has equipped seven hundred schools with ICT labs in a time frame of only forty-five (45) days. This was achieved through a partnership with NIIT, a private computer training institute. The Government of Karnataka contracted with NIIT to equip and maintain the school computer labs and provide an instructor for technical training for students during school hours. In exchange, the training institute is compensated with a 5-year contract for providing the training and is allowed to use the facilities after school hours for delivery of its private training courses to the community.

Some examples of PPPs under the CAL interventions of the SSA programme are:

- The States of Andhra Pradesh, Rajasthan, Orissa, Uttar Pradesh, Bihar, Nagaland, and Assam have adopted a BOOT (Build on Operative and Transfer) model. Private firms are given the responsibility of installing hardware/software and provide approved e-learning material and teacher training for a mutually agreed upon time period.
- The Rajya Shiksha Kendra in Madhya Pradesh, in association with Bhoj University, has developed interactive lessons for students at the elementary school level on VCDs titled "Headstart" in Hindi. These CDs are also being used by other Hindi speaking states in the country.
- In Uttarakhand and Tamil Nadu, training on CAL has been done in partnership with Microsoft. Teacher training is being imparted with the help of HARTRON in Haryana, INTEL in Gujarat, Himachal Pradesh, Kerala, and Tamil Nadu.
- In Kerala, Karnataka, Andhra Pradesh, Tamil Nadu, Gujarat, and Orissa, the Azim Premji Foundation has been associated in developing teaching and learning material for the CAL interventions.

A recent example of a varied PPP model that has addressed the specific aspects of efficient implementation of ICT in school education delivery systems is the partnership between the Ministry of Information Technology, Government of India, Indian Institute of Technology (IIT) Bombay and Vigyan Ashram, an NGO. The experimental study, called e-shikshak, was successfully implemented in six schools in rural Maharashtra. The model is based on the ICT-based tools developed by IIT Bombay that are transferred to the schools for their use and has received very positive feedback from the students. The NGO facilitates effective dialogue between IIT Bombay and the schools, and helps identify the appropriate person from each school to serve as the liaison. The NGO's familiarity with the local language and the school administration make it the point of contact.