1. India

India is the seventh largest and second most populous country in the world. It is bordered by Pakistan, the People's Republic of China, Nepal, Bhutan, Bangladesh, and Myanmar.

Figure 1: *Map of India*
Source: www.wikipedia.org; www.cia.gov

The Indian economy has been growing at a steady high pace for the past decade, with growth being supported by market reform, robust capital markets, and sustained flow of FDI. Structurally 54% of GDP is contributed by the Services sector, industry and agriculture contribute 29% and 17%, respectively. However, more than 60% of the population is dependent on agriculture and 25% of the people still live below the poverty line. Administratively India is divided into 28 States and 7 Union Territories, with more than 618 districts and is a functioning parliamentary democracy.

Some of the key demographic and economic indicators are given as follows:

Table 1: Key Demographics and Economic Indicators - India

Parameter	Value	Year
Population	1,169,016,000	2007
Gross domestic growth (million US $)	1,141,346	2007
GDP per capita (US $)	976.3	2007
Human development index ranking	134/182	2009
Population below poverty line	25%	2007

Source: http://unstats.un.org; www.cia.gov; http://hdr.undp.org

1.1. Background

The education system in India is administered by the Ministry of Human Resource Development at the center and the different Departments of Education at the state level. Education is a concurrent subject, which implies that Indian states and the federal government both have jurisdiction over the sector; although the Government of India provides the overall policy framework, financial support and guidelines to ensure a national standard of education, implementation is primarily done at the state level.

The government of India has been making significant progress in achieving the goals of universalization of elementary education. Since 2001, the government's flagship education scheme Sarva Shiksha Abhiyan (SSA), which was implemented in partnership with the state governments, has been successful in significantly increasing enrollments and reducing the gender gap in primary education. With the relative success of SSA, the government has now taken up universalization of secondary education in a mission mode through the implementation of the Rashtriya Madhyamik Shiksha Abhiyan. The passage of the "Right to Education" bill is another significant milestone in the task of ensuring equal access to quality basic education for all. The bill was passed by the parliament in August 2009, making education a fundamental right for every child in the country.

The reform agenda in education was given further impetus with the setting up of the National Knowledge Commission (NKC) in 2005, with the mandate of providing a blue print for reform of the educational sector in the context of the emerging knowledge society. The NKC recommendations outline a roadmap for strengthening the education system from school education to general higher and professional education, as well as skill development in India, with a focus on how to leverage available technologies to improve access and quality of education.

Some of the key education indicators for the Country are given as follows:

Table 2: Education Indicators - India

Education parameter		Value	Year
Adult literacy rate	Male	70.2	2000–2007
	Female	48.3	2000–2007
Youth literacy rate	Male	87	2000–2007
	Female	77	2000–2007
Gross enrollment ratio (%): Primary education	Male	114	2000–2007
	Female	109	2000–2007
Gross enrollment ratio (%): Secondary education	Male	59	2000–2007
	Female	49	2000–2007
Expenditure on education (% of GDP)		3.2	2003–2006

Source: www.unicef.org; www.cia.gov

The IT and telecom sector in India have made significant progress. India has more or less maintained its position in the ICT development index, ranking 118th in 2007 (International Telecommunication Union –Measuring the Information Society, 2009). It still has very limited bandwidth per Internet user and low home computer and Internet penetration rates. It is

surprising to see such a low Internet penetration rate particularly since the price basket for Internet services is low when compared with other countries in the region. This suggests that price of ICT services is not the main barrier to higher ICT levels; it is more likely due to limited ICT infrastructure or limited access to it.

Some of the key ICT indicators for the Country are given as follows:

Table 3: ICT Indicators - India

ICT parameters	Value	Year
Internet users (per 100)	6.9	2008
Internet subscribers (per 100)	1.09	2008
Broadband subscribers (per 100)	0.45	2008
Mobile coverage (%)	61	2007
Mobile subscribers (per 100)	20.8	2007
Personal computers (per 100)	3.17	2006–2007
Internet affordability (US $/month)	6.6	2007
Mobile affordability (US$/month)	2.5	2007
Radio subscribers (per 1000)	107.3	
Households with TV (%)	32	

Source: www.itu.int; www.mdgs.un.org; World Development Indicators Database; www.cia.gov

1.2. Policy Framework and Delivery Mechanism

The importance of using ICT for improving education has been emphasized for over a decade in India, right from 1992 the National Policy on Education emphasized using educational technology to improve the quality of education. ICT has also figured comprehensively in the norms for schooling recommended by the Central Advisory Board of Education, in its report on Universal Secondary Education, in 2005.

Consequently major government schemes have a component of funding allocated for using ICTs and focused initiatives such as the ICT @ Schools scheme are geared toward making opportunities available to students for developing their ICT skills at the school level. A glance at the Eleventh Five-Year Plan also reflects the importance of ICT in the education scenario of India. To harness the capacity of ICT in delivering educational services, a national ICT initiative, the National Knowledge Network has been launched based on the recommendation of the NKC, with the collaborative effort of the Ministry of Human Resource Development (MHRD), Department of IT and Department of Telecom, that will make its presence felt in 378 Universities and 18,064 colleges. The network will focus on digitization and networking of the educational institutions, making available bandwidth to facilitate collaborative research and knowledge sharing. Further, the National Mission on Education through ICTs launched by the MHRD aims to leverage ICTs to provide high-quality, personalized, and interactive knowledge modules over the Internet/intranet to all learners in higher education institutions, any time anywhere.

A coherent policy level framework for the use of ICTs in school education in India was recently initiated through a stakeholder dialogue on formulating a draft national policy for ICT in education,

led by the Ministry of Human Resource Development, Global e-Schools Initiative (GeSCI), and Centre for Science, Development and Media Studies (CSDMS). Based on feedback received a draft "National Policy on ICT in School Education" has now been published for comments and revision. In terms of ICT literacy for students, this draft policy document proposes implementing a programme for ICT literacy for all secondary schools, suggesting that all states develop an ICT literacy curriculum to instill basic as well as advanced ICT skills among secondary school students. At the higher secondary stage, the draft policy states that ICT-related elective courses will be offered in schools which will be taught by a postgraduate teacher with appropriate qualifications. To foster an environment of ICT-enabled teaching-learning, the draft policy states that competent teachers will be encouraged and given the resources to adopt ICT-enabled practices in teaching-learning. For this purpose, the transformation of classrooms into SMART classrooms (classrooms equipped with a wide range of ICT facilities including computers, projectors et cetera, used to teach the curriculum) will be catalyzed. As for ICT infrastructure, the draft policy states that each school will be equipped with at least one computer lab and a minimum of a 10:1 student computer ratio will be maintained. Policies regarding other ICT facilities and enabling infrastructure and their delivery mechanism have also been articulated in the draft policy document. There is also a focus on capacity building of teachers as well as state/district education department personnel and on using ICT for open and distance learning (ODL).

1.3. Initiatives

A large number of Initiatives using ICT at all levels of education are ongoing in India, some at a pilot stage while others are operating full scale in a large geography. While individual states in India have significant ICT-related interventions in their education systems, major initiatives operating at a national level in educational institutions are profiled here. Some of the major initiatives taken by the government are:

ICT @ Schools Scheme

The ICT @ Schools scheme was launched in 2004 with a view to provide opportunities to students to develop their ICT skills as well as use ICTs to aid the teaching learning process. Under this scheme, support is provided for procurement of computers, peripherals, software, connectivity, and so on. The scheme is currently being implemented in all states and union territories of India in government and government-aided secondary and higher secondary schools. The scheme also aims to set up SMART schools in Kendriya Vidyalayas and Navodaya Vidyalayas, both central government school systems, to act as "Technology Demonstrators" and to lead in diffusing ICT skills among students of neighboring schools. The scale of the project is demonstrated in the funds released by the government of India to the states from 2005 to 2008, which amounted to about INR 3.2 Billion (approximately USD 68 Million).

Sarva Shiksha Abhiyan

SSA is a flagship programme of the Government of India in partnership with the state governments to support the states in creating, developing, and strengthening the formal primary and upper

primary school systems. SSA is a time bound mission, with the objectives of ensuring Universalization of Education and bridging gender and social gaps by 2010. The SSA program is largely funded by the Government of India but is also supported by the World Bank, Department for International Development, and the European Community (EC) with the World Bank being the largest contributor.

The SSA encourages states to use ICT and the satellite EDUSAT (Education Satellite) to provide distance education within states to supplement school education. Distance education has been naturally chosen as a catalyst for expediting SSA. Further, the Management Information System tool under SSA is a significant part of the project as it facilitates monitoring of the physical and financial parameters of the scheme. The system has District Level, State Level, and Ministry Level modules. At each level, role-based access control is provided for different functions from entering relevant school level data to generating and reviewing consolidated school, district, and state level data. The basic MIS functionality has been supplemented in some states like Orissa and Uttar Pradesh by introducing features like GIS, Child Tracking, and so on. In 2007–08, the District Information System for Education was operational in all 624 districts in the country and collected information on 1.25 million institutions providing elementary education, with more than 5.61 million teachers.

Almost all the states in the country are implementing central schemes such as ICT @ Schools, SSA, Mission on Education through ICT and have significant number of students enrolled in open learning systems at the school and college levels. In addition to central schemes, states have their own major ICT-related initiatives in educational institutions.

Some examples of education initiatives using ICT in different states are:

"Chalta-Phirta Mobile Bus" is a bus fitted with a television screen and equipped with computers, multimedia facilities, a book library, blackboard and toys and is to go around the slum clusters of New Delhi where children do not have access to education. Each bus will have two teachers specially trained to educate children through books, computers, exhibits, films et cetera.

"Eklavya computer-aided self-learning" is an initiative in Chhatishgarh to provide fully animated multimedia software based on textbooks of classes 6 to 8, which has been loaded on touch screen computers and kept in the school corridors for easy access by children.

IL&FS Education and Technology Services Limited (IETS) is in the process of implementing IT solutions for SSA Bihar by setting up hardware, creating curriculum, introducing multimedia lessons, IT skills for teachers, and teacher training. IETS will also setup and maintain Computer Labs in 200 schools. Each lab will have computers, printers, UPS, generators, and computer teachers.

Universal Service Obligation Fund

Universal Service Obligation Fund (USOF) was established in India in 2002 under the Ministry of Communications and Information Technology, Department of Telecommunications. The fund is exclusively utilized for providing access to telegraph services, mobile services, and broadband connectivity to people in the remote and rural areas at affordable and reasonable prices. Funds are raised through a Universal Service Levy (USL), which is a percentage of the revenue earned by certain telecom service providers and through grants and loans provided by the central government. Since its inception USOF has initiated many projects to provide telecom infrastructure in rural areas; some of these projects are mentioned in the following:

Public Telecom and Information Services: USOF provides and maintains public access facilities such as Village Public Telephones (VPT) and Rural Community Phones (RCP) in village and rural areas. USOF has provided subsidy support toward providing/maintaining a VPT in every revenue village as per the Census 1991 and 2001. Subsidy support has also been provided for every village having a population of more than 2,000 and no existing PCO to install public telephones by way of RCPs. By 2008, USOF had facilitated 530,833 VPTs.

Individual Access: In terms of empowering individuals in rural areas, USOF has provided Rural Household Direct Exchange Lines (RDELs) to the rural population. It has also provided one time subsidy support to 9 million RDELs installed before April 2002 and 4.2 million installed after 2002.

Mobile Infrastructure: 7,871 mobile infrastructure sites spread across 500 districts and 28 states are being rolled out. This was by way of sharing subsidized passive infrastructure (tower, boundary wall et cetera) by three telecom service providers having their own subsidized active infrastructure. A second phase of this scheme is in the pipeline which aims at covering even more sparsely populated uncovered areas.

Broadband Connectivity: An agreement has been signed with BSNL where USOF will provide subsidy towards broadband connectivity from about 28,000 rural exchanges spread across the country.

USOF's commitment to extent the reach of telecommunication to rural areas in India can help the country overcome the prevalent digital divide and can enable stakeholders to deliver education to these underserved areas.

(http://164.100.9.221:8080/usof-cms/usof_roadmap.htm)

EDUSAT—Education Satellite

Indian Space Research Organization (ISRO) launched EDUSAT (Education Satellite), the first Indian satellite built exclusively for serving the educational sector. It was launched primarily to serve the need for an interactive satellite to enhance the distance education system in the country. Many projects have been initiated to impart education through the satellite.

The Virtual Classroom Technology on EDUSAT for Rural Schools (VICTERS) program is one such initiative. The program is an "IT @ School" project of the Kerala State Government envisioned to harness the EDUSAT satellite for training teachers, providing high-speed net connectivity to schools, and for implementing learning management solutions.

The Rajiv Gandhi Project for EDUSAT Supported Elementary Education (RGPEEE) is another initiative aimed at harnessing the benefits of EDUSAT; it is a collaborative project of Indira Gandhi National Open University (IGNOU), Ministry of Human Resource Development (MHRD), and ISRO. The project promotes the use of EDUSAT in enabling teachers to incorporate ICT in elementary education. It is operational in Madhya Pradesh, Chhattisgarh, Uttar Pradesh, and Bihar.

Navodaya Vidyalaya Samiti

Navodaya Vidyalaya Samiti (NVS) is an autonomous organization under the Ministry of Human Resource Development, Department of Secondary & Higher Education Government of India. Its significance lies in providing quality education to the rural population who has been deprived of quality modern education typically available in urban areas. It is an attempt to realize the goal of setting up residential schools to bring out the best of rural talent envisaged in the National Policy on Education 1986. Each of these residential schools is known as Jawahar Navodaya Vidyalayas (JNV). NVS has integrated a number of ICT facilities in each of the 576 schools spread across the rural areas of the country.

Hardware and Connectivity

All schools are equipped with computer labs for students in class 6 and above. The computer-student ratio on an average is 1:12 across all schools. In addition to computer labs most schools have one "SMART" class, which is equipped with LCD televisions, projectors, Internet, and other multimedia facilities.

NVS envisions the need of 40 computers per school since the maximum number of students admitted per class is 40. This way every student gets to interact and use the computer on a one-on-one basis at least

Figure 2: Computer classroom of JNV
Source:PwC

once a day. However, due to financial constraints some schools have a fewer number of computers but a minimum of 20 computers is maintained.

Internet connectivity is supplied through VSAT (A Satellite Communication System) but is available for only 300 schools out of 576 schools. Since all JNV schools are located in rural areas, poor Internet connectivity is a major constraining factor for implementing ICT in schools. However, the schools that are located in the cities such as New Delhi do not face as many problems in terms of Internet connectivity.

> *"The procurement of hardware is relatively easy; the only constraint is the cost of maintenance. Even though all schools have an electrician for any minor repair, for all major ones the hardware companies are reluctant to travel to remote areas where JNV schools are typically located, on an average they take 6-8 days to visit the schools."*
>
> **M.S. Khanna, Joint Commissioner NVS**

> *"Due to the geographic location of JNV schools another constraining factor is access to electricity. Some states like Bihar and Haryana have electricity for only 6-8 hours in a day, on some days Orissa doesn't have access to electricity for 24 hours. Although some schools have a power back up, this is not a common feature in all schools due to financial constraints."*
>
> **M.S. Khanna, Joint Commissioner NVS**

> *"JNV Mungeshpur has one computer lab with 40 computers, each class which contains 40 students have 2-3 periods (40 minutes each) per week to work in the computer labs. Children of younger ages (class 6 and 7) learn basic computer skills in these sessions, and as they progress to subsequent classes the sessions change from learning basic skills to using software to learn subjects such as Mathematics and English. Apart from the computer lab, the school also has one "Smart Class" containing an LCD Television, a computer, a projector and printers."*
>
> **Prit Singh, Principal JNV Mungeshpur**

> *"Internet speed is very good, the only challenge we face is in terms of maintenance of the machines. It becomes difficult to get engineers to come and fix just one computer."*
>
> **D.K. Mehta, Physics teacher, JNV Mungeshpur**

Software and Content

Since NVS has tie ups with various content development agencies, the cost of procurement of software is minimal. For example, Microsoft offers a 96% discount on its software. Other content development agencies collaborating with NVS include Oracle, Intel, and EduComp. Software is used

predominantly for teacher training and curriculum development (Intel publishes and develops content). Apart from collaborating with software companies some of the content used in the schools are also developed by the teachers. Therefore, there is no uniform software used in the schools.

> *"There is no standardization for educational software. Teachers decide what software they should use therefore it varies from school to school. Teachers are also given the freedom to develop and teach their own software since they have the best knowledge of the curriculum which needs to be taught. There is also no system of evaluating the software and its efficiency; however teachers are encouraged to provide feedback on the software and interact with each other to suggest the most relevant software."*
>
> **M.S. Khanna, Joint Commissioner NVS**

> *"We are absolutely free to develop our own study plans by using programs such as Microsoft Power Point however a major constraint is the low quality of anti-virus installed in school computers, I spent weeks developing a study plan only to find that a virus had wiped out all data stored in the computer"*
>
> **Sarita Govil, English teacher at JNV, Mungeshpur**

> *"We use the internet for our class work but internet buffering is extremely slow, since each period is only for 40 minutes it is very difficult to complete any class work. The school should also teach more advanced programs for example the C++ software in the school computers is outdated, when I participated in a computer science exhibition I had to use a more updated version of the software which students from other schools were very familiar with."*
>
> **Science Student, JNV Mungeshpur**

Teacher Training

NVS collaborates with a number of private companies to provide teacher training. Intel has been partnering with NVS for the last 10 years and has not only trained the teachers but principals of JNV schools as well. Oracle has trained teachers through distance/Web-based training. Microsoft has provided training for its own software.

> *"Cost of teacher training is high, even though Microsoft and Intel provide free of cost training it is costly and cumbersome to get all the teachers together. Since each and every teacher needs to be trained they rely on the Web to train teachers this leads to a lack of interaction between the teachers. There is also a lack of trained teachers for NVS schools as teacher salaries can not*

> *compare to the competitive salaries received in the IT sector. Most qualified people would prefer to work for private companies as opposed to schools particularly schools in the rural areas which is where NVS schools are located."*
>
> **M.S. Khanna, Joint Commissioner NVS**

> *"Even though the teacher training programs conducted by Intel and Microsoft have been extremely helpful, due to lack of resources teachers lose touch with the computer language. Most teachers do not have computers at home; even at school we have access to only a few computers."*
>
> **T.P. Singh, Geography teacher, JNV Mungeshpur**

Financing

NVS is completely financed by the government. The main costs include teacher training and hardware procurement and maintenance; software is cheaper particularly due to the discounts offered by most companies. For the maintenance of hardware/software each school receives INR 1,00,000 (approximately USD 2,147) by NVS. As for the maintenance and installation of VSAT, which is provided through the Education and Research Network (ERNET), the government spends approximately INR 62 million (approximately USD 1.3 million) on all schools.

> *"The total cost on ICT last year was relatively lower than previous years where it has on an average been INR 750 million per year (approximately USD 16 million). The dip in total expenditure is probably owing to the fact that hardware has already been installed in most schools and this expenditure is not reoccurring."*
>
> **M.S. Khanna, Joint Commissioner NVS**

JNV schools have also received many prestigious awards; a total of 13 schools received the Computer Literacy Excellence Award (CLEA) for 2005. The award which is sponsored by the Ministry of Communication and Information Technology is a INR 0.15 million (approximately USD 3,200) cash prize.

Kendriya Vidyalaya Sangathan

Like NVS, Kendriya Vidyalaya Sangathan (KVS) is also an autonomous organization of the Ministry of Human Resource Development; however, its aim is to cater to the educational needs of the children of transferable Central Government Employees including Defense Personnel and Para-Military forces by providing common programme of education. KVS is tasked with the responsibility of establishing and maintaining Kendriya Vidyalayas (Central Schools). At present, there are 978 KVs in India with one school each in Kathmandu, Moscow, and Tehran. Over the last 4 years KVS has made extensive efforts to promote ICTs in its schools.

Hardware and Connectivity

With the number of computers installed in KVs increasing by more than 27,000 in the last 4 years, each KVS is now able to maintain a Pupil:PC ratio of 25:1. Almost 97% of all KVs have a computer lab along with at least one ICT teacher. All computer labs have Internet access either via broadband or VSAT.

> *"Apart from computer integration almost all [KVS] schools have broadband connectivity. Each school has also created their own Web sites based on the guidelines provided by KVS."*
>
> **Somit Shrivastav, Education Officer—ICT Roadmap and Infrastructure, Kendriya Vidyalaya Sangathan**

Content

As an autonomous body each Kendriya Vidyalaya is free to decide on the content to be used in the classrooms. Teachers are given the freedom to use content they deem suitable, with collaboration and training from software companies such as Oracle and Microsoft.

Teacher Training

Over the years KVS has been able to make effective use of ICT infrastructure installed in schools by empowering its teachers and developing their skills to help them use ICT in the teaching learning process. This has been made possible by interventions from Corporate Social Responsibility divisions of IT companies such as Microsoft Corporation, Intel Corporation, and Oracle. Besides training teachers, the companies have also created learning structures in the schools. A brief description of the interventions is mentioned in the following:

Project "Shiksha," Microsoft

KVS has collaborated with Microsoft to implement Project "Shiksha" (literally meaning knowledge), which focuses on teacher training programs as well as monitoring the effectiveness of the training programs in the schools.

Teacher training under Project Shiksha aims at enabling teachers to use technology in the classroom; they are trained on using visual presentation of theories and concepts in the curriculum. The teachers are trained after school hours to ensure that the project does not interfere with the daily school routine. The training lasts for a period of 10 days by working 3–4 hours per day.

Microsoft has also supported KVS in introducing a subject in respect of information technology for all students from the 6th to the 10th standard. For evaluating the success of Project Shiksha, Microsoft intends to set up a quality review program. For this purpose, Microsoft along with a representative from KVS will make quarterly visits to schools participating in the teacher training program. The findings from this visit will be circulated to KVS headquarters and the concerned

Microsoft representatives.

Intel Education Initiatives

KVS has also signed an MoU with Intel in order to facilitate the integration of ICT in KVs. Intel's initiatives are aimed at using "ICT as part of the curriculum." As a first step, Intel organized Principal Leadership Forums for 750 KV Principals. Through these forums Intel gave them an insight into understanding how technology integration in the classroom can positively impact student learning. For the KVs that have been classified as "SMART" schools by the MHRD, Intel provided guidance to the principals and teachers on how to use the ICT facilities for various institutional processes (both school systems and the teaching/learning process).

Professional Development Programs were also conducted by Intel through the Intel Teach Program. The aim of the program was to enable in-service teachers to effectively integrate technology to enhance student learning, use technology to support Project-Based Learning, and to encourage active inquiry and Higher Order Thinking skills among the students. Intel also provided online resources from where lesson plans can be freely downloaded. In terms of curriculum, Intel has supported KVS in introducing a new ICT subject in the curriculum for students and teachers of grades 6 and 7.

"Under the program 506 'Master Teachers' or 'Resource Persons' have undergone the 50 hour training program. These resource persons have in turn trained other teachers of the school or neighboring KV's" (Somit Shrivastav, Education Officer—ICT Roadmap and Infrastructure).

Think.com, Oracle

KVS collaborated with Oracle to introduce think.com in its schools. At Think.com, students can create their own Web pages, work on projects, and interact with children in other parts of the world. Oracle also provides a series of refresher and training courses available through face-to-face as well as online programmes.

Following a successful Think.com pilot project in 25 KVs in October 2004, KVS decided to rollout Oracle's Think.com initiative to more than 900 of its schools. Oracle initially trained master trainers selected by KVS who then trained schools administrators and other teachers and students in the schools.

Financing

According to Somit Shrivastav (Education Officer—ICT Roadmap and Infrastructure), all KVs are financed by the government through KVS; however, in terms of ICT, the KVs are self-financed, that

is, they use the funds obtained through admission fees. In case if these funds fall short KVS provides additional funds for that quarter.

National Institute of Open Schooling

The National Institute of Open Schooling (NIOS), formerly known as the National Open School, was set up in 1989 in pursuance of the policy focus in the National Education Policy 1986 on open learning. The NIOS is partly funded by the government and is responsible for providing education to all those who are not able to attend the formal school system. In addition to providing the regular range of school subjects, the NIOS also provides vocational and community-oriented courses. The NIOS has the authority to conduct and certify examinations for secondary levels, and its certification is recognized by all universities in India.

A total of 371,625 students out of which 30% were girls enrolled in all National Open Schools across the country in the academic year 2008–09. New Delhi has the highest enrollment rate contributing to 27% of the total rate. NIOS has made significant progress in universalizing education; almost 20% of the students at NIOS are schedule castes or scheduled tribes. ICT is being used as a major strategy toward "Reaching the Un-reached" and management of NIOS.

At the secondary and senior secondary level, NIOS provides a wide range of subjects and a flexible self-paced learning system. Learning strategies include learning through printed self-instructional material, audio listening and viewing video programmes, Personal Contact Programme (PCP), and Tutor Marked Assignments (TMA). Audio and video are significant components of the education dissemination system at NIOS as these programs complement and supplement the other channels of learning. NIOS has produced 242 video programmes and 260 audio programmes, which are made available to NIOS Study Centers all over the country. NIOS learners can take these programmes for rent from centers close to them. Some of the educational video programmes are telecast on the national Doordarshan channel while the audio programmes are broadcasted on the radio.

NIOS is planning to utilize EDUSAT for live interactive sessions in a phased manner. In the first phase, the NIOS studio will be connected to 11 regional centers, which would be expanded to 100 study centers in the second phase. This is an effort to facilitate direct face-to-face interaction between the learners and the teaching community.

In 2005, NIOS started an ICT-based On-Demand Examination (ODE) Testing Center at the secondary level at its headquarters in New Delhi. The ODE system aims at creating a system in which examinations are independent of timeframe and students can give examinations as per their wish and preparation. ODE testing centers are equipped with computers, which randomly generate questions out of an already developed question bank. With the success of ODE at the secondary level, NIOS started ODE at the senior secondary level as well in 2007. ODE is conducted every month four times a week and the results are declared in the following month on the NIOS Web site.

NIOS has also introduced an Online Admission facility through the NIOS On-Line (Ni-On) Project to facilitate the learners in registering themselves for the courses. It also has the facility of

computerized result declaration and a variety of online courses ranging from traditionally academic to vocational studies.

NIOS has collaborated with Cisco to offer Cisco Networking Academy Programs in 10 accredited vocational institutes. The program focuses on teaching students how to design, build, and maintain computer networks. Cisco will provide PC hardware and other IT essentials, Web-based course materials, 24-hour technical support, and nominate a representative to aid in the implementation of the program. NIOS plans to scale this program in 100 accredited vocational institutes.

Indira Gandhi National Open University

The IGNOU is a higher education institution; as an open education provider, it has been at the vanguard of developing and maintaining standards in open learning in India and is a significant milestone in any discussion on the use of technology for education. The University was established in 1985 by an Act of Parliament with the dual responsibilities of (i) enhancing access and equity to higher education through distance mode and (ii) promoting, coordinating, and determining standards in open learning and distance education systems. Since then, the IGNOU has undergone rapid expansion and emerged as an international institution in the field of ODL. The University offers various academic programs through an Open and Distant Learning mode. The Electronic Media Production Centre (EMPC) at IGNOU is responsible for production, dissemination, and transmission of educational software; it develops audio-video programs to supplement the courseware of IGNOU. EMPC coordinates the following:

- Gyan Darshan: A fully digital 24 hour exclusive Educational TV channel.
- Gyan Vani: Stations which relay programmes contributed by the government, NGOs, state open universities, governmental institutions et cetera.
- Teleconferencing: One-way video and two-way audio teleconferencing facility.
- Interactive Radio Counseling: A one-hour live phone-in counseling program offered on 188 All India Radio stations every Sunday.
- Education Research and Training (ERT): ERT unit of EMPC is engaged in developing academic programs, conducting research and training related to media and communication.

To discharge its second responsibility of coordinating and maintaining standards in ODL systems, IGNOU through the Distance Education Council (DEC) extends technical and financial support to Open and Distance Education Institutes (ODIs) for development of technological infrastructure, institutional reform, professional development and training, student support services, computerization, and networking for improvement of quality of education. The DEC also performs a regulatory function with respect to ensuring minimum standards in ODL systems throughout the country.

Gyan Darshan/Gyan Vani

An educational television channel DD-Gyan Darshan has been set up by the national telecaster Doordarshan and IGNOU with assistance from the Ministry of Education (MoE) and many educational software makers. It has four round-the-clock channels offering interesting and

informative programs for school-going children, college students, and youth seeking career opportunities.

Gyan Vani is an educational FM radio channel with day to day programs contributed by various Ministries, educational institutions, NGOs, and national level institutions such as IGNOU, NCERT, UGC, IITs, and open universities. Gyan Vani serves as a medium for niche listeners and for addressing local educational, developmental, and sociocultural requirements.

National Knowledge Network

The National Mission on Education through ICT, launched in 2009, aims to leverage ICTs for enhancing the teaching learning experience of learners. A high-speed digital broadband network, the National Knowledge Network, is envisaged for interconnecting the country's major research and educational institutions, colleges, and universities. A structured empowered committee will be in charge of coordinating the activities of creation and implementation of the content, application, and establishment of the network. The Mission has two major components: content generation and providing connectivity, including last mile connectivity for students and institutions. On the content generation front, a wiki style collaborative platform under the supervision of content advisory committees is envisaged. Renowned institutions and educators will be part of the content generation effort and different activities in respective areas of excellence may be coordinated by them. Existing resources like the National Program of Technology Enhanced Learning (NPTEL) and the Multimedia Educational Resource for Learning & Online Teaching (MERLOT) could contribute to this exercise. In the Eleventh Five-Year Plan, an amount of INR 46 billion (approximately USD 0.9 billion) has been assigned for the Mission with a budget provision of INR 5 billion (approximately USD 0.1 million) for the financial year 2008–09.

Sakshat Portal

The Sakshat Portal launched by the MHRD in 2006 is a single window portal for all education-related needs of students, teachers, and lifelong learners. It provides a range of services from informational services like details of scholarships, tests, educational resources, as well as interactive services like a discussion forum, one-on-one sessions with teachers, career counseling, and video conferencing facility. Content development for each subject was entrusted to a Content Advisory Committee (CAC) consisting of representatives from institutions like IGNOU, Delhi University, KVS, NVS, NIOS, and NCERT, as well as prominent academicians in the field.

Free and Open Source Software (FOSS) in Education

The Open Source community offers a database where educational institutions can tap the full potential of software available in the Open Source domain. This software which is available free of cost is developed, tested and upgraded by programmers and users on a regular basis. India annually hosts one of the largest Free and Open Source Software (FOSS) events in the world – FOSS.IN, an event that focuses on FOSS development and contribution. In April 2005, the Ministry of Communications and Information Technology, Government of India set up the National Resource Centre for Free and Open Source Software (NRCFOSS) in an effort to bridge the digital divide and strengthen the Indian software industry. NRCFOSS encompasses Research & Development, Human Resource Development, Networking & Entrepreneurship development and it serves as a reference point for all FOSS related activities in the country. (http://nrcfoss.org.in/)

In India the adoption of open source solutions is primarily under the state governments. The IT@School project was initiated by the Government of Kerala in 2000 to provide ICT enabled education in the state. Since its inception, the project has implemented ICT enabled education in over 8000 schools in the state, with a focus on capacity building of teachers and students. In 2004, a customized GNU/Linux version called IT@Schools GNU/Linux was developed by the Free Software Foundation of India (FSF) and Kerala State IT Mission (KSITM). The Society of Alternative Computing and Employment (SPACE) was tasked with its installation and distribution. Within 2 years most of the schools conducted practical examinations on FOSS platform and SPACE customized the software to enable teachers to collate marks and grades.

The backbone of the project is its strong network of 200 Master Trainers and 5,600 School IT Co-ordinators (SITCs) in the state. Some of the significant features of the project include:
- World's largest simultaneous deployment of FOSS (Free and Open Source Software) based ICT education
- Extensive 7 Continuous Capacity building programmes for Teachers and Students
- Infrastructure Up-gradation of schools under ICT scheme
- Broadband internet connectivity to all schools in the state, norms for usage by ensuring safe & secure browsing
- Hardware Clinics- first of its kind to repair damaged computers and to upgrade the hardware in schools
- Unique scheme for electrification of classrooms to fuel ICT enabled education.
- ICT based Content Development for teachers and students
- E-Governance Initiatives in General Education department
- School Wiki – to promote collaborative content development & local language computing (www.schoolwiki.in)
- EDUSAT initiatives in the state including ViCTERS educational channel

Media Lab Asia

Media Lab Asia (MLAsia) has been set up by the Department of Information Technology, Government of India, as a not-for-profit Research & Development organization. Its administrative headquarters is in Mumbai; however, the project will be scaled to other parts of Asia as well. MLAsia works with academic and R&D institutions, industries, NGOs, and the Government to develop relevant technology and culturally appropriate solutions for the common man. Many projects undertaken in the areas of ICT for village livelihood generation, healthcare education, empowerment of the disabled, and rural connectivity are now undergoing test deployment and are being made ready for national/large-scale deployment.

Some of the key education-related projects undertaken by MLAsia are:

Gyanpedia is an interactive portal for collating, organizing, and circulating contents generated in schools in India through a single open web platform. The initiative with support from the Digital Empowerment Foundation (DEF) aims to give a boost to nationwide e-learning and e-education efforts. It has online presence of over 50,000 students and covers 10 States.

Virtual Laboratories for Life Science Experiments: MLAsia in collaboration with Centre for Development of Advanced Computing (C-DAC) has developed 40 Virtual Life Sciences Experiments, which use multimedia technology to simulate a virtual classroom environment. These virtual classrooms are available on CDs and multimedia cards for mobiles.

Many other small-scale initiatives are being piloted in collaboration with Indian Institute of Technology and other research organizations in different states of the country.

In addition to Media Lab, organizations like C-DAC and the National Informatics Centre (NIC) have been developing products and services to improve access to ICT services at all levels of the government.

ICTs are also being used extensively for education in India through the pioneering efforts of some private players and NGOs, some of these are outlined in the following:

National Institute of Information Technology

National Institute of Information Technology (NIIT) is a global IT solutions company, which offers training programs to students and professionals. It aims to use ICT to transform the teaching-learning process into a more interactive and efficient process. NIIT's training programs are based on the concept that "You don't have to be an engineer to excel in the IT industry."

With NIIT's vision that computer education can be delivered to schools through collaboration between the State Governments and NIIT, the "Build-Operate-Transfer Model" was initiated. Under this initiative, computer education for class 6 to 9 was handed over to NIIT for a period of 5 years after which the school would continue providing training without further assistance. During this period NIIT was also entrusted with the responsibility of training teachers. Within 45 days 3,500 schools were equipped with computers.

NIIT has also set up "Minimally Invasive Education Kiosks" all over the country. This initiative is conducted under Hole-in-the-Wall Education Ltd. (HiWEL), which is a joint venture between NIIT and the International Finance Corporation (a part of the World Bank Group) aimed at promoting literacy among underprivileged children of the slums. NIIT first experimented with Minimally Invasive Education Kiosk in a slum in Delhi to discover whether students in slum and rural areas could learn through these education kiosks or "learning stations." In 2000, after noticing positive results, they set up 30 Learning Stations in a resettlement colony with the help of the Government of Delhi. Currently, there are more than 300 learning stations across the country. HiWEL has also been awarded the coveted "Digital Opportunity Award" for its groundbreaking work in spreading computer literacy and improving the quality of education at the grassroot levels, by the World Information Technology and Services Alliance (WITSA).

Since NIIT could not offer extra curricular activities such as debating, sports et cetera, they formulated the NIIT + University concept known as GNIIT (Graduate from NIIT). NIIT would provide a four semester (2 year) technical training course to students already enrolled in a State University. They would also provide a one-year work placement for students to gain professional experience in the industry; for this one year they will receive a stipend, which would cover the entire fees for the two-year NIIT course. At the end of four years, students become graduates of an Indian University, acquire an NIIT professional diploma in Network-Centered Computing, and gain hands on experience in the industry. Till date, GNIIT has provided 15,000 people with professional practice with more than 5,000 companies.

Azim Premji Foundation's Computer-Aided Learning Program

Azim Premji Foundation is a not-for-profit organization, which works in the area of elementary education in rural areas. In 2002, it initiated the Computer-Aided Learning program (CALP) to harness the potential of computer technology for education. Under this program, the foundation along with the government has set up Computer-Aided Learning Centers (CALC) to improve academic learning levels, attract out of school children, provide child centric education to retain students, and reduce absenteeism of teachers and students. While the government provides computers and required hardware to schools to establish these centers, Azim Premji Foundation provides syllabus-based bi/trilingual multimedia contents. The program has covered approximately 16,000 schools across 14 states in the country.

Intel Education Initiative

The mission of the Intel Education Initiative is to improve teaching and learning through the effective use of technology in classrooms. Intel has been active in India since 1999 when it

collaborated with NVS. They have primarily focused on joint initiatives with the government at the central, state, and local levels. Ever since its inception in India, it has trained more than 570,000 teachers from 14 state governments. It has also focused on building technology literacy and 21st century skills for youth living in rural communities who have little or no access to technology. Intel carries out its objectives through a portfolio of programs:

Intel Teach Program (In-service Program)

The Intel Teach Program is a professional development program that helps classroom teachers integrate technology to enhance student learning. The program follows the "Train the Trainer Model" where the teacher learns how, when, and where to incorporate technology into his/her lesson plans. Teachers are also taught how to create assessment tools and align lesson plans with provincial learning outcomes.

The teach program also includes the training of school administrators and principals on effective ICT implementation. For this purpose, Intel organizes Principal Leadership Forums. These forums are intended to give leaders an opportunity to understand how technology integration in the classroom can impact student learning. After the forum, the principals are encouraged to motivate teachers to get trained to enhance student learning using technology. The Intel Teach Program portfolio includes both face-to-face training and online resources and tools.

Intel Teach Program (Pre-service Program)

The Intel Teach Pre-service Program aims to empower the faculty in teacher education institutions to train their students with the knowledge, skills, and attitudes required to integrate technology-supported project-based learning into the future classroom. During the training, pre-service teachers are taught how to integrate technology in their classroom processes.

Project "Shiksha," Microsoft

Microsoft in collaboration with government bodies, schools, and other stakeholders initiated Project "shiksha" in an effort to accelerate computer literacy for teachers and students across government schools. The project will deliver affordable software solutions and comprehensive training for students and teachers. By 2008, Microsoft had signed MoU's with 10 states for 11 academies offering a variety of educational software and training programs, which will update teachers on how to integrate computers in classrooms. By June 2008, more than 200,000 government school teachers and 10 million students had received IT training. Project "Shiksha" was awarded the Skoch Award in 2006, which is given for exceptional work done in the educational sector by IT companies.

Digital Empowerment Foundation

Digital Empowerment Foundation (DEF) is a not-for-profit organization dedicated to bridging the digital divide by providing consultancy services to the government and corporate in providing ICT facilities to rural areas. It therefore serves as platform for stakeholders including the government, private companies, and NGOs to bring forth their knowledge and expertise to the rural population who live on the edge of information and economic benefit through innovative interventions of ICT tools and digital media. Human resource at DEF includes 72 ICT experts and professionals dedicated to fulfill the objectives of the foundation.

In terms of digital content, in 2008, DEF launched the D-content Web site (www.dcontent.in), which is a thinking platform for various stakeholders to express their views and concerns on digital technology and content matters. D-content's news magazines are available online as well as in the form of printed magazines. With support from Media Lab Asia, DEF also launched Gyanpedia, India's first multilingual e-content platform for the learning community. It aims at facilitating educational content sharing and exchange to bolster e-learning and e-education. It has aggregated digital content from 7 states, 7 languages, and 7 classes (6th-12th) with students and teachers from over 300 schools contributing to its content. In its future plans, Gyanpedia aims at expanding its resource base by covering a total of 5,000 schools. The content offered by Gyanpedia can be accessed by the teaching learning community through their website www.gyanpedia.in/

In October 2004, DEF in partnership with World Summit Award, Government of India, and various other stakeholders launched the "Manthan Award," which is an initiative to recognize the best practices in e-content and creativity in India. After four years of its inception, it expanded its operations to cover all the SAARC countries.

DEF has also initiated numerous other projects and has been providing consulting services in terms of digital content, e-governance, community radio et cetera to various stakeholders. (http://defindia.net/)

Centre for Science, Development and Media Studies

Centre for Science, Development and Media Studies (CSDMS) is a Non-Governmental Organization that has been involved in the field of development research. It is committed to developing solutions for underprivileged societies through the use of ICT (both advanced technology as well as more traditional ones such as print) and Geographic Information systems (GIS). The various activities under CSDMS involve research in the filed of ICT and GIS, undertaking developing projects in Geo-ICT, creating a platform for knowledge sharing, organizing globally renowned conferences, and capacity building through training programs. In the education space, CSDMS has partnered with GeSCI in coordinating, facilitating and implementing the policy formulation process for the "National Policy on ICT in Education" draft. Through "Digital Learning" and "e-India," CSDMS has created a platform to bring stakeholders together to exchange ideas and gain knowledge regarding the potential of using ICT in the education system. ***Digital Learning*** is a monthly education magazine which focuses on current trends, perspectives, researchers, discussions, and initiatives of various countries of the world in the field of ICT and education. Digital learning content is made available to the public through three modes; an interactive Web site (www.digitallearning.in/) with news, interviews, resources, and articles updated daily; a monthly print magazine and a weekly email newsletter. Every year CSDMS organizes the ***eINDIA*** conference which is an international conference and exhibition aimed at creating a platform to facilitate a multi-stakeholder partnership as well as professional networking among governments, industry, academia and civil society organizations of different countries in the field of ICT for development. Key speakers for the conference include many experts in the field of ICT and development including education experts, in 2009 key speakers from the education sector included the Joint Secretary, Ministry of Human Resource Development; Vice Chancellor, Indira Gandhi National Open University; Secretary, Department of Higher and Technical Education; Joint Secretary, E-learning Group MCIT and Secretary, Secondary Education Government of Andhra Pradesh. Details of past and future conferences are available on the eINDIA website www.eindia.net.in/

(http://www.csdms.in/)

Community Radio

Up until 2006, only well-established educational institutes were granted the license to set up campus Community Radio Stations (CRS) in India. The government recently updated their policy guidelines to allow even NGOs such as the civil society and voluntary organizations to receive the license to set up CRS. The growth in community radio stations since then has been slow. The government had anticipated that within a few years of the policy change India would witness the establishment of 4,000–5,000 community radio stations; however, there are only 19 community radio stations established so far (Ministry of Information and Broadcasting, CRS status-at-a-glance). One of the reasons for the slow growth in the establishment of CRS is that the process of acquiring a license to set up the stations takes over a year since it goes through the approval of many ministries.

The Ministry of Information and Broadcasting is however optimistic about the future growth of CRS and expects 5,000 CRS to start functioning by 2012. They have envisaged a need to organize workshops to spread awareness of community radio and to encourage NGOs and other voluntary organizations to set up community radio stations. During the year 2009–10, the Ministry of Information and Broadcasting organized 2-day state level consultations for 10 states in India. (www.mib.nic.in/)

Educomp Solutions Limited

Educomp Solutions Limited is one of the largest education services companies in India. Educomp offers a range of education services and products from multimedia content and SMART classes, to programs in vocational education and training, for both private as well as government schools.

Through its EDUReach programme it has partnered with State and Central Government agencies, Ministries of IT and HRD, and Governments of other countries in order to bridge the digital divide. Educomp has partnered with fourteen State Governments, namely Government of Assam, Karnataka, Orissa, Tripura, Gujarat, Uttar Pradesh, West Bengal, Tamil Nadu, Haryana, Jharkhand, Rajasthan, Punjab, Chhattisgarh, and Andhra Pradesh, covering over 14,000 government schools and benefiting 7.7 million students studying in government schools in India. Educomp programmes provide implementation support for infrastructure creation, teacher training, and content development.

Content is created in local languages in most of these projects and is based on a combination of computer literacy and curriculum-based content. Some of the programs offered by Educomp include:

- Multimedia Curriculum Content in Regional Languages
- Computer Education Programme
- Teacher Training: Technology-Aided Learning (TAL), Pedagogy & Cognitive Learning Issues
- Professional Development Program for Educators

- Educomp Tele-Education Network

Several other initiatives are ongoing at different levels of education which are doing pioneering work in developing innovative technology-based solutions from content development, to delivery; a brief mention of these initiatives is made in the following table:

Table 4: Other ICT in Education Initiatives - India

Name	Initiative	Geography	Further Information
Education Development Center(in partnership with USAID)	Technology Tools for Teaching and Training (dot-EDU T4): dot-EDU T4 has created interactive, multimedia tools in audio, video, and software formats to provide pedagogical training and support for teachers as well as subject specific instruction directly to students focusing on girls and other vulnerable populations	Madhya Pradesh, Bihar, Karnataka, Rajasthan, Chhattisgarh, Jharkhand, and Delhi	http://idd.edc.org /T4India
Education & Research Network, ERNET	ERNET was set up with assistance from UNDP as the premier education and research network in India interconnecting major institutes of higher learning in India. At present ERNET is largest nationwide terrestrial and satellite network with point of presence located at the premiere educational and research institutions in major cities of the country. ERNET aims not only to provide connectivity, but to meet the entire needs of the educational and research institutions by hosting and providing relevant information to their users. Research and Development and Training are integral parts of ERNET activities.		
National Library and Information Services Infrastructure for scholarly	The National Library and Information Services Infrastructure for scholarly content (N-LIST) is proposed to be built around electronic resources subscribed by	All India	

content(N-LIST)	the UGC-INFONET Digital Library Consortium for the universities and the INDEST-AICTE Consortium for technical institutions (IITs, IISc, and NITs). The project envisages providing access to electronic resources to Universities, technical Institutions & Colleges		
Information and Library Network INFLIBNET, and Developing Library Network, DELNET	Information and Library Network and DELNET are computer communication networks for linking libraries and information centers in universities, deemed to be universities, colleges, UGC information centers, institutions of national importance, R&D institutions, etc in order to promote resource sharing among libraries in India	All India	http://www.inflibnet.ac.in/ http://delnet.nic.in/
National Programme on Technology Enhanced Learning (NPTEL)	A collaborative effort of seven Indian Institutes of Technology (IITs) and the Indian Institute of Sceince IISc Bangalore, NPTEL aims to enhance the quality of engineering education in the country by developing curriculum-based video and Web courses. In the first phase of the project, supplementary content for 129 Web courses and 110 courses in video format in engineering/science and humanities have been developed.	All India	http://nptel.iitm.ac.in/
Multimedia Educational Resource for Learning and Online Teaching (MERLOT)	MERLOT is a free and open resource designed primarily for faculty and students of higher education. It provides a platform for peer reviewed online teaching and learning materials and allows sharing advice and expertise about education with experts.	All India	http://www.merlot.org/

Manthan Awards for e Content	Manthan Awards launched by the Digital Empowerment Foundation in partnership with World Summit Award and American India Foundation in 2004, is an initiative to reward and recognize innovative e-content in the Development sector. Organizations and initiatives producing innovative content in sectors like health, education, government, livelihoods generation etc are recognized and felicitated. It has recently expanded its scope to include initiatives from all South Asian countries.	Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka	http://www.manthanaward.org/
GeSCI	GeSCI is a nonprofit and non commercial organization that works with the goal of providing assistance to government in the strategic implementation of ICTs in education. GeSCI follows a demand driven, collaborative and comprehensive approach to ensure a seamless improvement in the teaching standards, thereby transforming education and empowering communities. It has taken up initiatives based on strong partnership and close collaboration. The services provided by this organization works closely for shaping plans and designing policies, building capacities within the MoE, and utilizing ICT cost effectively to achieve educational objectives.	All India	www.gesci.org
Commonwealth of Learning (COL)	COL is an intergovernmental agency dedicated to promoting and delivering distance education and open learning. In developing countries it supports governments to improve access to quality education. COL is voluntarily funded by the	All India	www.col.org

	Commonwealth countries and India is third major donor after United Kingdom and Canada. The organization has focused its attention on activities in developing instructional materials, telecommunication technology, training and information service. COL has located its Educational Media Center for Asia (CEMCA) in India and Joint Secretary in charge of Distance Learning is a member of the Advisory Council of CEMCA.		
Same Language Subtitling for Literacy	PlanetRead is a not-for-profit organization dedicated to reading and literacy development around the world which was originally created around the idea of Same Language Subtitling (SLS). SLS is the idea of subtitling song-based programs on television in the "same" language as the audio. Since India is a country of 600 million television viewers and a deep-rooted passion for film songs, PlanetRead saw an opportunity to use SLS to rapidly transform hundred of millions of early-literates into reading people by making reading a part of their everyday entertainment. This lead to the establishment of the Literacy for a Billion project which has been implementing SLS on several song-based TV programs on Doordashan, India's national broadcaster for the last ten years.	All India	
One Laptop Per Child (OLPC)	In India, OLPC ran a pilot project in a rural village near Mumbai in which every child was given a laptop; the project was then expanded to several other schools in different parts of the country. In 2009, the	Bangalore, New Delhi, Maharashtra	http://www.olpcindia.net/ http://www.olpc.in/

government of India placed an order for 250,000 XO laptops for 1,500 schools.

1.4. Constraints

India faces a number of unresolved issues and challenges for the adoption of ICT particularly in the education sector. Some of these issues are discussed in the following:

Low Literacy Level: Literacy levels in India are low, even those deemed to be literate are perhaps not competent enough to receive IT education. Educational standards would need to be raised before the citizens can become digitally literate.

Technophobia: To increase digital literacy levels among students and teachers, steps will need to be taken to overcome their technophobia. Teachers are typically wary of technology; this is the case for not only teachers in the rural areas but for those in urban areas as well. Unless teachers realize that training will help them rather than pose a threat to their jobs they will continue to remain hesitant. The first step therefore is to get the teachers on board. Raising awareness, about use of ICT in education and improving their teaching efficiency could help in developing positive attitude toward the use of ICT in education among teachers.

Monitoring and Evaluation: The penetration of hardware (computers) is fairly high in most schools as it is easy to install, however the level of usage is debatable; this is because there is no auditing or monitoring system to see whether students are actually using these computers.

Guidelines for Procuring Content: There are also no clear guidelines available for procuring quality content. Identifying quality content is a common constraint for schools looking to use ICT-enabled teaching learning practices.

Institutional fragmentation: Curriculum decisions, infrastructure decisions, content decisions, policy making, and policy implementation are all taken up by different bodies at different levels. Some harmonization/coordination is required.

Other constraints faced by India include linguistic diversity and income disparity. The digital divide in the country is so acute that it becomes difficult for the policy-makers to frame universal policies to be implemented.

1.5. Insights

India is a vast geography with varying levels of development in different parts of the country, and therefore, experiences of using ICTs for education across the country also reflect this diversity. At all levels, from infrastructure availability to availability of trained faculty, there is tremendous variation between urban and rural areas, developed and less developed states, and access for

economically and socially weaker sections vis-à-vis the more wealthy in the country. While some interventions have been immensely successful in one area, the same interventions in another part of the country have not succeeded. The most significant insight through this study has been that a whole spectrum of solutions using ICTs in the education space is required in India. This can range from initiatives using community radio for non-formal education through general community mobilization and awareness creation in rural areas to the state-of-the-art technology-enabled learning spaces and other advanced e learning practices in select schools.

While a small niche of elite private schools have access to the most advanced offerings of ICT-enabled education in the market, the bulk of government schools and poorer private schools face severe disadvantages in terms of infrastructure and capacity. Government's efforts will have to be focused toward this vast majority

India has a certain amount of basic infrastructure in place by way of access to hardware and connectivity; there needs to be a greater focus on developing relevant content and applications and using them to enhance learning across subjects to ensure improvement in quality of education. Content creation has to be democratized and made more responsive to the local context. While content creation by the teachers and students themselves is a positive trend enabling ownership, one needs to weigh the pros and cons of not having a professional content development team who can involve teachers and faculty in the process. On the other hand, large scale BOOT models for ICT enablement of schools often suffer because of lack of sustainability once the third party has finished its contractual obligations and installed hardware and content developed by it. A more detailed study of different models of content development and their relative success in India needs to be undertaken and based on the different environments, different models need to be adopted.

Off the shelf products also need to have some scope for flexibility and customization to give a sense of ownership to users. Further a much larger range of content has to be available, and several models to facilitate this content generation need to be explored. There are no clear guidelines and/or standards for content development at the national level, leaving individual institutions and state governments to choose, often without clear basis of judgment. There needs to be a balance between relative flexibility of the final users to decide on suitable content, and certain broad guidelines to assist them in judging the best possible solution while ensuring that certain minimum standards are maintained.

While the National Policy for ICT in Education is under formulation, there is an acute fragmentation of responsibility at all levels when implementing any ICT intervention, which often leads to dilution and lack of accountability. There is a need to coordinate the plethora of initiatives using ICT for education under a clear framework and guidelines to enable seamless integration of ICTs in education. Instead of focusing on one or two elements such as hardware or teacher training, an entire ecosystem for ICT-enabled learning needs to be created for which several aspects need to come together (refer Volume IV, Thematic Essays, Essay on Policy Coherence). Further, as state governments are the primary authority responsible for implementation of educational programmes, it is at the state level that a clear focus on utilizing ICTs effectively in the education space needs to be prioritized. Through the case studies, it is clear that states like Karnataka, Andhra Pradesh, and Delhi, which have placed adequate importance on mainstreaming ICTs in the teaching

learning processes and proactively initiated efforts to utilize ICTs for education, have succeeded more than states that are simply looking to implement central government schemes and create IT labs for their schools.

Infrastructure remains a key concern in rural areas, especially low Internet penetration and low levels of electrification are significant issues that need to be addressed at a system-wide level. National infrastructure building projects are ongoing like the Bharat Nirman Scheme, USOF's commitment to providing rural connectivity as well as specific programmes like the Knowledge Network or Mission on ICTs for education. These need to be effectively implemented and subsequently utilized at all levels.

While mobile phones have become almost ubiquitous in most parts of the country, their role in education per se is still evolving in India. Informal education and support services in education and distance learning programmes are making use of mobile phones for generating reminders, alerts, and scheduling, but given the limitation of the screen size and amount of data being exchanged, in their current commonly available models, mobile phones are not being utilized extensively in actual educational content delivery in formal education.

Relatively higher radio and TV reach provides an opportunity to deliver innovative content through these media. At present, the government provides dedicated educational channels on TV such as GyanDarshan I, II, and on the Radio such as Gyanvani. Private educational TV channels too have proliferated such as Toppers, Tata Sky Fun Learning, and so on; however, there is no systematic study done on the impact of these programmes on student learning or the success of these channels themselves. The traditional TV and radio programmes have been a useful supplement to distance education programmes and self-learning; however there are several disadvantages of these broadcasts in terms of lack of flexibility and limited interactivity. With the new generation of technological innovations, on demand options and interactive features have been incorporated in some programmes such as the Tata Sky's Active series. Tata Sky in collaboration with the British Council has launched the Active English channel, which is geared toward helping housewives in India learn conversational English including vocabulary and pronunciation from their homes. There are interactive features to choose from, including tutorials, exercises, and self-study modules. The medium of instruction at present is Hindi and content has been developed in partnership with the British Council. Given the reach of TVs, the relative low cost of installing a complete DTH package today (approximately 55 USD for the hardware, installation, and activation and an additional 5 USD as monthly subscription), this option can be explored more thoroughly.

The experience with the open education system so far has convinced policy-makers in the government at both the center and state levels that use of ICT in education has great potential to supplement the formal education system and to provide quality education to large segments of population through cost-effective, open, and flexible manner. Open education systems are initiated in most of the states; however, their development is at different levels. ICT needs to be used by both the formal and open systems as a common tool to provide quality education to masses because now education has been accepted as constitutional right of every individual in the country.

While states like Andhra Pradesh, Gujarat, and Karnataka are fairly advanced in their usage of ICT in the field of education, several other states lag far behind and may not even possess basic Web sites for government departments. Thus ICT uptake in education is fairly uneven in the country. As part of the current project, case studies of four states in India, Delhi, Karnataka, Rajasthan, and West Bengal have been taken up for detailed study. *(Refer to Volume II: Case Studies)*

1.6.   Select Bibliography

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- "Towards A National Policy on ICT in School Education in India, a Multi-Stakeholder Perspective." http://www.csdms.in/gesci/

Links to Initiatives

Government Links
- National knowledge Commission: www.knowledgecommission.gov.in/
- Sarva Siksha Abhiyaan: www.ssa.nic.in/
- Sakshat Portal: www.sakshat.ac.in/
- Media Lab Asia: www.medialabasia.in/

Schools and Education Institutions
- National Institute Of Open Schooling (NIOS): www.nios.ac.in/
- Indira Gandhi National Open University(IGNOU): www.ignou.ac.in/
- Kendriya Vidyalaya Sangathan (KVS): www. kvsangathan.nic.in/
- Navodaya Vidyalaya Samiti: www.navodaya.nic.in

Private Companies
- Microsoft: www.microsoft.com/india/education/pil/shiksha
- Oracle: www.oracle.com/global/in/pressroom/think_project.html
- National Institute of Information Technology (NIIT): www.niit.com
- Intel Education Initiative: www.intel.com/education/in/
- Cisco Education Initiative: www.cisco.com/web/IN/
- Educomp Solutions Limited: www.educomp.com

Non Government Organizations
- Azim Premji Foundation: www.azimpremjifoundation.org/html/
- Digital Empowerment Foundation (DEF): www.defindia.net/
- Centre for Science, Development and Media Studies: www.csdms.in/