CHAPTER I
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On July 1, 2015, Prime Minister of India, Narendra Modi launched the 'Digital India' campaign. The aim of this campaign is to "transform India into a digitally empowered society and knowledge economy" (Ministry of Electronics and Information Technology (Government of India), 2017). The effort is in the right direction so as to make the citizens aware and understand the importance of a technology driven society. The very fact that such an initiative was taken by the Indian Government, to make citizens aware of technology, shows that we are today in a world where knowledge sharing is an important facet of any economy and to survive in the competitive world everyone needs to be a participant.

This programme will help in setting a course of action considering that despite India's flailing performance on overall Network Readiness Index and in dismal rankings in terms of infrastructure and individual usage, it is in the top rankings when it comes to affordability. The initiative will help in empowering the citizens and lead India into a more digitally advanced age where other countries are moving ahead with greater speeds.

Networked Readiness Index (NRI) or **Technology Readiness** is being used as a means of "assessing ICT revolution globally", since 2001 across the 139 economies covered. Broadly this index focuses on three key areas- environment provided by countries/communities for adoption of ICT, "readiness of the stakeholders" and usage of ICT among these stakeholders. Networked Readiness Index (NRI) is published in Global Information Technology Report by World Economic Forum, INSEAD, Paris and Cornell University.

In the report of year 2016, India has slipped two ranks below than the previous year and is on an overall rank of 91. The report determines that even though the absolute score of India has changed slightly, this drop can be accredited to the other countries moving with ahead towards adoption of ICT. The report also identifies 'lack of infrastructure', 'low level of skills' and low 'individual usage' as the major hurdles to adoption of ICT. Despite the fact that India is one of the most affordable country in

terms of ICT (8th rank), illiteracy and the divide between rural and urban usage affect its prospects in terms of ICT. It is envisaged that the Digital India program will help in closing this gap and will help in betterment of digital infrastructure, digital literacy by providing different services to citizens online.

The **ICT Development Index** (**IDI**) is published by the United Nations International Telecommunication Union. It is currently based on 11 ICT indicators. It is considered an important tool for benchmarking and comparing performance of ICT within and across countries and to measure the divide, by governments, operators, development agencies, researchers and others. The IDI rank for India was 138 in 2016 and in 2017 it has improved to 134.

Table 1.1 Comparison Report of World and India on IDI (2017-18)

	World	India
IDI 2017 Rank	-	134
IDI 2016 Rank	-	138
IDI 2017 Value	5.11	3.03
IDI 2016 Value	4.94	2.65
IDI ACCESS SUB-INDEX	5.59	3.60
Fixed-telephone subscriptions per 100 inhabitants	13.57	1.88
Mobile-cellular telephone subscriptions per 100 inhabitants	101.53	86.95
International internet bandwidth per Internet user (Bit/s)	74464	15956.38
Percentage of households with computer	46.61	15.20
Percentage of households with Internet access	51.46	22.46
IDI USE SUB-INDEX	4.26	1.62
Percentage of individuals using the Internet	45.91	29.55
Fixed (wired)-broadband subscriptions per 100 inhabitants	12.39	1.44
Active mobile-broadband subscriptions per 100 inhabitants	52.23	16.76
IDI SKILLS SUB-INDEX	5.85	4.73
Mean years of schooling	8.52	6.30
Secondary gross enrolment ratio	84.00	74.28
Tertiary gross enrolment ratio	38.69	25.54

Note. Re-printed from *ICT Development Index 2017,* by ITU retrieved from http://www.itu.int/net4/ITU-D/idi/2017/index.html#idi2017comparison-tab

The report published in 2017 also lauds the Indian government's Digital India initiative to transform the country while focusing on ability of infrastructure, on demand services and empowering the citizens digitally (ITU, 2017).

Today, knowledge brings great power, it gives strength to the economy, to an individual and is an important asset to a nation. Thus, there is the need of acquiring skills to use new technologies to gain access of information. With the assistance of Information and Communication Technology, individuals can access information and understand the processes involved in acquiring and processing this information.

World Economic Forum in its Global Information Technology Report (2017) mentions that "the impact of ICTs on income growth and poverty alleviation are undeniable, and greater adoption of ICTs in lower-income groups will accelerate income gains at the base of the economic pyramid" (Pepper & Garity, n.d.). The study also highlights the benefits of technology on human capital emphasising the need of education and training in the area.

Technology has touched every imaginable facet of life, from booking tickets for travel/ entertainment to buying groceries online. However, such an influence and intervention has long been awaited in education. With many researches being conducted on effect of technology in classroom, a clear picture is yet to emerge. Is the money being invested by governments across the world yielding any outputs? Have we come to the point where technology will revolutionise education?

Information and Communication Technology

'Information and Communications Technology' was first used by Stevenson in his report in 1997 to the United Kingdom Government and was promoted by the Government in 2000 in its National Curriculum documents (FOLDOC, 2000 as cited in Wegerif, 2006)

UNESCO (2007) defines ICT as:

"The term 'information and communication technologies' (ICT) refers to forms of technology that are used to transmit, process, store, create, display, share or exchange information by electronic means. This broad definition of ICT includes such

technologies as radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, and computer and network hardware and software, as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs."

In his guest article published in Indian Education Review, Bakshi (2012) describes Information and Communication Technology (ICT) as "*basically an umbrella term that encompasses all communication technologies such as internet, wireless networks, cell phones, satellite communications, digital television etc. that provide access to information."*

"Information and communication technologies are computer based tools used by people to work with information and communication processing needs of an organisation. Its purview covers computer hardware and software, the network, and other digital devices like video, audio, camera and so on, which convert information (text, sound, motion, etc.) into digital form." (Moursound & Bielefeldt, 1999)

Draft of National Policy on Information and Communication Technology (ICT) in School Education, 2012 by Department of School Education and Literacy under MHRD, Government of India, describes ICT as:

"all devices, tools, content, resources, forums, and services, digital and those that can be converted into or delivered through digital forms, which can be deployed for realising the goals of teaching learning, enhancing access to and reach of resources, building capacities, as well as management of the educational system."

The draft policy further outlines the hardware required and other processes that come under purview of ICT. The hardware includes computer connected devices and their software applications, interactive digital content, satellite communications, internet, radio and television, web based content repositories, LMS, MIS and interactive forums. The processes required to digitise content are also included with development and presentation of content, platforms for capacity development and creating forums for exchange of information and interaction.

ICT and Education

"To become fully literate in today's world, students must become proficient in the new literacies of 21st century technologies. As a result, literacy educators have a responsibility to effectively integrate these new technologies into the curriculum, preparing students for the literacy future they deserve."

Position statement by International Reading Association (IRA), 2009 (as cited by Hutchinson and Reinking, 2011)

UNESCO, 2002 in its report on 'ICT in Education' while discussing "ICT infrastructure, hardware and connectivity" describes ICT as amalgamation of the two terms IT (Information Technology) and CT (Communication Technology):

Information Technology deals with the equipment and software they use for storing, accessing, organizing, processing and manipulating the information, electronically; computers, digital cameras and scanners along with multimedia software and programs for database storage are part of this technology. Communication technology covers the aspects of equipment which helps in connecting the devices through modems, phones, faxes and also computers.

ICT's foray into business, on one hand has helped many modern corporations to achieve success and on the other, it has helped governments to achieve infrastructure which is efficient. At the same time it has added value to the teaching and learning process and better management and organisation of learning institutions. Since, internet is considered to be responsible for this amount of development and innovation, citizens need to be well versed in skills to not only use internet but also skills which are independent of any specific technology platforms (i.e. computer hardware/software) to keep abreast of changes happening in the field.

Thus, with the change in the society and the economy, the skills required to succeed in life have also changed. The basic skills of an individual are not limited to reading, writing or mathematical ability but they also include thinking and reasoning logically, solving complex problems, and even to write (i.e. present explanations, arguments) in a persuasive manner. The ability to find, evaluate and apply new knowledge with flexibility is also important. Information literacy is now the important part of the repertoire of skills which needs to be possessed by individuals of 21st century. It is the

confluence of knowledge, its understanding, set of skills and even attitude to fully contribute to the information society. When students are information literate, they develop ability to select, interpret, evaluate, manipulate and present information. A taxonomy based on Bloom's objectives has also been proposed by Churches (2009). This taxonomy describes how different technological tools available in classrooms today can be used to achieve the objectives as per Bloom's taxonomy. The author emphasizes that the teacher in the classroom does not need to begin at the lower level thinking tasks but can begin anywhere. The taxonomy presents comprehensive examples of how different tools available can be used to develop cognitive skills in the learners, e.g. searching for information is part of 'remembering' domain while performing advanced searches using search engines is part of 'understanding domain'. Similarly, when students can create and present content using variety of tools, it is under the purview of 'evaluating and creating' domain. The author also emphasizes collaborating among students which can occur at any level of task.

A brief outline of competencies which are the requirement of the present scenario (UNESCO, 2002):

- *"Critical thinking*
- *General technological competencies*
- *ICT competencies required to work*
- *Decision making*
- *Handling dynamic situations*
- *Working as a member of team*
- *To be able to communicate effectively"*

The pervasive nature of technology cuts across all areas of our society and its economic life. Since the advancements in the technological field are swift – the chances of it becoming obsolete are high. Hence adaptation is the key; which is only possible if there is a thorough understanding of ICT- the concepts and principles involved. And there is no better way to develop this understanding of ICT than at the grass-root level, i.e. in schools.

For ICT to play a beneficial role in education, "social development, economic growth, educational reform and educational management" should form a part of its guidelines

in implementation (Kozma, 2008; Moonen, 2008; Tilya, 2008 as cited in Voogt, Knezek, et al, 2011)

Computers or any technology has always been considered a drug which on injecting in the education system, especially the teaching and learning process, would cure it of its shortcomings. This 'drug' has often been associated with positive change and renewal in the society. What is often overlooked is the fact that introducing or integration of any technology in classrooms is not a simple and straight forward process; in fact it is a "multifaceted process" (Tinio, 2005). The participants i.e. the teachers, students and even administrators must be motivated, change their attitude, and their belief towards use of technology (Joneja, 2011).

Albrini (2007) has described the transformation of change that has led to evolution of education to its present form, in great detail. The 19th century public education system came into existence in answer to the Industrial Revolution. And with evolution of technology (i.e. computers and other related devices) the criteria and qualifications leading to job opportunities changed. And when, in the 21st century the Industrial Revolution paved way for the Information Technology revolution; the society shifted from being product based to the one based on exchange of information.

The thought of using computers in the field of education began in mid-1950s. The driving force behind the introduction of computers in schools was partly the information industry's requirement of a knowledge system, wherein people could be trained to serve this industry (Poole, 1995 as cited in Albrini, 2007). The introduction of technologies assured democratisation of learning, increase accessibility to new and more information sources, to "decentralize instruction", to provide easier communication facilities and to help students to explore and collaborate beyond the classroom (Poole, 1995; Olson, 1974; Warschauer and Healey, 1998 as cited in Albrini, 2007). However, all these potentials remained unfulfilled when computers were used to strengthen the existing teaching and learning practices like using projectors for presenting content in class, instead of being used to open new avenues in the teaching and learning process (Jonassen et al, 2003 as cited in Albrini, 2007).

The scenario of 1980s saw a shift in use of computers in schools, 'Learning environments' and 'cognitive tools' were designed for use in education and, drill programs, tutorials and computer managed instruction found their place. By 1990s,

change was witnessed in education with emergence of internet and web based content. And the internet became the means of bringing the outside world in the classroom, while opening limitless avenues for learners (Trend, 2001 as cited in Albrini, 2007).

In the present scenario, ICT has found place in our classrooms; schools have begun to use digital interactive boards in the classroom, they are managed by MIS (Management Information System), they have their own websites and often communicate with parents through them and the student- teacher relationship has also evolved beyond classrooms. And like every other commodity, the technology has also brought a divide with it between haves and have nots. The disparity in availability of technological tools is quite visible especially in a country like India, wherein the government managed schools are far behind the public schools in terms of infrastructure, accessibility, staff and many other impending factors. Needless to say that this 'digital divide' does not undermine the important role played by technology in our present day society but it further strengthens the imperative need to close this gap.

Lloyd (2005) describes four widely used form of technology in classrooms:

- 'Learning about ICT' which involves having basic knowledge of computers and basic operational skills for the same
- 'Learning with ICT' which entails usage of ICT in the curriculum rather than its isolated usage
- 'Learning from ICT' which is important in today's scenario because of the widespread and prolific usage of Internet
- 'Learning through ICT' as technology gives opportunity to collaborate and reflect in both on-line and off-line mode.

Technology in schools can impact various aspects like content acquisition, higher order thinking skills of students, integration of technology, teacher's morale and competency (Baylor and Ritchie, 2002). Technological tools can be used to gather information or for practicing (drill and practice), using these tools as they are will not bring any change unless they are made a part of the instruction methods; to be made a

part of cognitive structure the technology needs to be put in the learners context (both classroom and societal).

When the computer is used as a 'cognitive tool', its purpose is to analyse, compare, contrast or evaluate and to possibly help in thinking i.e. providing opportunities for reflection and manipulation of information, thus, affecting higher thinking processes. Usage and accomplishment by students will help in motivating teachers; making technology a part of their pedagogy will help them and students both. Although barriers are commonly observed such as- lack of resources, paucity of time for integrating/using technology in lessons, etc. but recognition of the importance of technology in today's classroom will initiate revamping or restructuring of teacher training programs. This will help the new teachers to gather and become proficient in ICT skills and training of the older staff will help in them in dealing/using with technology easily. In both the scenarios the students will benefit largely.

Defining ICT Integration

"To integrate is to seamlessly combine components, parts or elements into a complex but harmonious whole"

- Lloyd (2005)

Technology Integration can be explained as "how transparently the technology was blended into the lesson, and whether it was used to convey content in ways not easily done without technology." (Baylor and Ritchie, 2002)

Integration of ICT is "multi-factorial" (Brown, 2004; as cited in Baskin and Williams, 2006) and the five factors involved in this process are:

- Curriculum Integration: how technology relates to the curriculum goals and content prescribed by the schools
- Spatial Integration: how technology is grafted in the activities of the classroom
- Temporal Integration: how well are the classroom activities interlinked with the learning activities of the classroom
- Pedagogical Integration: are the technological tools chosen for teaching and learning process aligned to the teaching methods/approaches

- Attitudinal Integration: do teachers and students consider technology problematic and to what extent.

Kozmo (2000) and Milton (2003) have given a list of indicators or factors which depict the successful integration of ICTs, these are outlined as:

- Environment and culture supporting and promoting innovation
- ICT tools being used to support pedagogy
- Collaborative learning
- Hardware in working condition/reliable
- Access to experts
- Technology provided by schools
- Technological competency of teachers
- Technological support provided
- Maintenance and needful upgradation of resources (software as well as hardware)
- Pedagogical skills or preference for some ICT tools by teachers
- Resources available to teachers and students
- Skills of students
- Motivation of students

(as cited in Lloyd, 2005)

UNESCO (2010) has described the Integration of ICT in teaching and learning process as progressively occurring in 4 stages. The first stage is “Emerging” wherein one becomes aware of potential of ICT tools and these are applied to increase productivity, “Applying” is the stage where ICT is used in a specific way for a specific subject in order to enhance the traditional methods of teaching, this stage is followed by “Infusing” ICT use on the understanding that when and how it can facilitate the instruction leading to “Transforming” which is the ideal stage where an innovative environment is created for creation and management of information.

Global Initiatives for ICT

The paradigm shift in the field of education has called for measures to recognise and comprehend the impact of technology on our day to day life, particularly in the field of education. Hence, efforts are being made around the world to harness the potentials of technologies especially for the field of education.

Education for All (EFA) was declared in Jomtien in 1990 where education was defined as "a basic knowledge, values, attitude, skills necessary for an individual to survive, to live and work with dignity and to continue learning." To achieve this goal, use of ICTs was emphasised upon.

Delores Report- **'Learning the Treasure Within' (1996)** describes four pillars of learning- "Learning to know", "Learning to do", "Learning to live together, learning to live with others" and "Learning to be". It recognised the importance of using 'information technologies' for improving quality of education at that time.

UNESCO World Education Reports have also emphasised the importance of new technologies in the teaching and learning process, over the years. Their report of **1998** suggests that learning can be improved with the help of ICT, if:

- students and teachers can have access to technology in classrooms and teacher training institutes,
- digital content that is relevant and meaningful is available,
- teacher uses technology to help students achieve better academic standards
- information available is used to meet our present generation learner's needs

Millennium Development Goals (MDGs) adopted by United Nations in 2000 also emphasised that the technology available should be used to benefit education "especially Information and Communication."

The **UNESCO report of 2002** included guidelines for ICT usage by Teacher Education/Educators and also, stressed the importance of collaboration between students and with the society to enrich their experiences by sharing them. The tools which can be used for this are e-mail, bulletin boards, chat , conferencing (audio/ audio-video), etc.

UN launched a **ICT task force in 2001** and its mandate ended in 2005; UNGAID was established in 2006 and can be called its successor, though it differs in its structure and is more of an informal platform. ("What was the UN ICT Task Force", n.d.)

UN GAID (a global alliance for ICT and Development) refers to ICT related issues and accounts for communication between different stakeholders. It aims to bring economically weaker sections of the world at par with the rest of the world by providing opportunities to use ICT. One of its aims is also to recognize best practices and disseminate them to other parts of the world from the areas of "Education, Entrepreneurship, Governance, Health" with keeping "gender, rural development and connectivity" in consideration. ("Global Alliance for Information and Communication Technology and Development", n.d.)

The initiatives mentioned above are very limited in comparison to the projects and schemes being designed all over the world to deploy use of technologies in education. A blog by the World Bank mentions the top 20 educational technology projects happening around the world (Trucano, 2017). Countries like China have announced their mission of promoting use of ICT in education and completing the mission by 2030. European commission has also many ongoing initiatives to encourage advancement of ICT for education, many projects are going on in African countries to provide education through use of ICT as well. India has also announced and is working towards many projects in education.

Status of ICT in Education in India

In 1972, Educational Technology Programme was started to bring quality to Indian education system. Under purview of this, Centre of Educational Technology (CET) was set up in National Council of Education, Research and Training (NCERT) and State Institutes of Educational Technology (SIET) in Andhra Pradesh, Bihar, Gujarat, Maharashtra, Orissa and Uttar Pradesh were also set up; in other states Educational Technology (ET) cells were established.

The Government of India launched CLASS (Computer Literacy and Studies in Schools) in 1984 as a joint venture between MHRD and Department of Electronics.

During the initial phase selected schools were to help teachers and students to be familiarized with different computer applications and realize the potential of computers for the teaching and learning process. Later, this program was adopted by 8th five year plan as a centrally sponsored scheme.

National Policy on Education, 1986 suggested that Educational Technology should be used as a tool to improve education, for betterment of life. And suggested that this technology was one of the ways by which deprived sections of our country could be reached.

The Programme of Action for National Policy of Education (1986) in 1992 made specific mention of access of ICTs to promote education in both primary and secondary education.

National Curriculum Framework, 2000 stressed on the importance of integrating ICT in our schools. NCERT designed IT syllabus for schools and emphasised the importance of technology in the field of education and for our changing society.

CLASS was revised in 2001 and introduced in Kendriya Vidyalayas (KVs) and Navovidyalayas (NVs) as the concept of SMART schools. Its purpose is not only to introduce computers and related technology but to develop skills for the new economy in our students.

ICT@Schools was initiated by Government of India by combining the two schemes of Educational Technology (ET) and CLASS in 2004.

EDUSAT was launched by ISRO in September 2004, to specifically serve the educational sector of our country. It was the first satellite launched for this purpose. Apart from serving the formal educational sector (i.e. schools and colleges) it also helps serve the non-formal education sector. Subsequent launching of INSAT, INSAT-1A and INSAT-1B helped strengthen the case for ICT in Indian educational scenario.

National Curriculum Framework (2005) by NCERT also recognises the importance of ICT and states that ICT resources can be used to close the digital divide and should become a means of providing equal opportunity especially in remote areas. The need of the hour is to develop such curriculum for education that helps in “inter

disciplinary" learning and "cross disciplinary" thinking. The teachers need to recognise and accept their roles of a facilitator and help students to become independent learners.

The Information Technology Policy (2005) recognised the importance of ICT in governance, socio-economic condition and "enhancing service-delivery". VISION 2020 Programme was envisaged by the erstwhile President A.P.J. Abdul Kalam and entails all round development of the education system by integrating technological tools (ICT), keeping in mind the sustainability and environmental concerns.

SAKSHAT, an online portal, was launched by President of India in 2006. This portal by MHRD offers free online content. Contributors are renowned experts of different subject areas who in collaboration with other experts keep adding more content for higher levels. In addition to providing written course content, animations, simulations, video lectures (asynchronous), web links related to content, questions and answers, the web portal also provides dropouts or illiterates information about computers and using them without any dependency on reading or writing.

Sarva Shiksha Abhiyan (SSA) aims to "universalise elementary education" under the directive of 86th Amendment Act of Indian Constitution by providing free education for children aged 6-14. Apart from its focus on empowering through education and education of girl child, it also aims to improve infrastructure or build new schools, training of teachers, digitisation of materials and improving the support to the educational system. It also attempts to close the digital gap by providing access to technology.

National Mission on Education through Information and Communication Technology (NME-ICT) was launched by MHRD in 2006. The aim is to promote ICT enabled education and create opportunities for accessing network, even in remote areas. It also hopes to empower students by providing low cost tablet computers, Akash. The primary objective of the mission is to provide not only schools and colleges but everyone working- "a one stop solution" to their learning requirements; to prevent wasting of time and resources in looking for information as per requirement and to effectively utilise the intellectual resources.

Draft **National Policy of ICT in Schools** (2012) recognises the potential of information and communication technologies in betterment of the school education system. The composition of these technologies largely depends on the a policy which envisions its sustainable growth in the present knowledge society. It describes the stages of ICT competency level for schools (Basic, Intermediate and Advanced). Enabling infrastructure to be acquired and its financing is also outlined in the document.

The goals of the policy as given in the document are represented as follows:

- To create environments in which ICT can be utilised and benefits can be reaped from its usage. The usage of these technologies has to be in environment of "collaboration, cooperation and sharing" in order to obtain optimised returns.
- Promotion of equal, free and open access of ICT in order to create networks of stakeholders (teachers, students, schools, etc.) to encourage development and creation of content.
- To encourage 'experimentation' with and in ICT tools and their practices; to promote research in the areas related to ICT and understanding of its usage benefits and limitations.
- To encourage and motivate society members to help strengthen school education system through suitable usage of ICT.

The draft policy gives a complete and detailed plan of how ICT is to be used and enabled in the school education system.

CBSE (Central Board for Secondary Education) has also encouraged schools to establish at least one classroom with computer, projector and LCD screen to initiate adoption of ICT for education. On its portal iCBSE.com, it mentions that establishing such classrooms will the first step in the direction and will help teachers to teach the content through multimedia resources and gradually, the content for different subjects can be taught using multimedia as schools keep adding such classrooms.

Central Institute of Educational Technology (part of N.C.E.R.T.) is the national level body which promotes use of technology in education. It is responsible for producing multimedia content for radio, television as well as internet in order to

enhance the transaction of curriculum at different levels of school education. It works in collaboration with various government bodies in the area of education to further the cause of promoting use of technologies in education. **NROER** (National Repository of Open Educational Resources) is one of the recent initiatives by this institute.

Many new schemes employing ICT in different capacities by Ministry of Human Resource and Development, Government of India have been launched. These include: **E-paathshala** developed by NCERT which aims to disseminate various educational resources, **Shaala Sidhdhi** which has been developed by NIEPA for evaluating schools against common core standards, **Shaala Darpan** launched initially for Kendriya Vidyalayas to provide services for managing schools through School Management Systems and **Saransh** launched by CBSE to help students and parents to assess their school against different parameters to schools at state and national level.

Issues Affecting Usage of ICT

Because of large investments being made in ICTs for education, it is imperative to assess their situation. According to Info Dev's document Knowledge Maps: ICTs in Education (2005), the significant issues affecting their adoption and usage are as follows:

- "Impact on learning and achievement
- Monitoring and evaluation
- Equity
- Costs
- Best practices
- Tools
- Teachers and Teaching
- Content and Curriculum
- Policy"

The usage of any new technology depends on how it is being perceived by the society and what is its effect on economy. In case of education, all of these issues are interrelated, to promote use of technology in education systems in a country, a policy framework has to be in place along with reduced costs on the economy to be able to

sustain it. The members of the society should have a favourable attitude towards these technologies which requires training of teachers and availability of infrastructure to everyone in the society/ community, to utilize the training. The curriculum being taught should have provisions to incorporate the practices; monitoring and evaluating the whole system needs to be done to ensure that government or the agency investing should get return on its investment in form of technologically enabled workforce.

Thus, as strengthened earlier, integration of ICT in teaching and learning systems is a complex process requiring changes to happen together in the whole system. Delay in this process creates divide between haves and have-nots.

ICT Tools

Many hardware and software tools (ICT) are available today which can be employed in the classrooms. Using these ICT tools and media help in:

- Structuring and processing a task
- Help in accessing information resources
- Help in presentation of data in many forms such as visual (through images, video, graphical representation of data) and in audible form.

Since, ICT in its purview consists of both hardware and software with networking, following list of ICT tools mentions their usage in classroom/ school context:

- Computers, laptops, mobile devices (e.g. Tablets, mobile phones, iPads, etc.)
  Computers and laptops are being used to present information to learners either through different software or resourcing information through internet or presenting content through PowerPoint, editing through MS Word, PDF files, images, etc.
  Mobile devices have brought the concept of BYOD (Bring your own device) where each student may bring their iPad or laptop or tablet to classroom and are not dependent on hardware resources provided by schools. Mobile phones can be used to communicate with teachers and peers or setting reminders,

which help in ‘performance support’. Mobile devices have become prevalent and their usage needs to be studied in detail to understand their impact on learners; ‘m-Learning’ is the concept of teaching-learning through mobile phones.

- Audio-Visual Aids

  Audio- Visual aids (A/V aids) help in communicating with learners through both picture and sound.

  Projectors are used to display the content being shared with learners on large screen so that each student is a participant of the content sharing taking place in the classroom. Other visual aids include: tapes, DVDs, television, etc.

  Audio aids help in supplementing the video and add more depth to the information being shared on screen like speakers, microphone, radio, etc. A projector connected with a speaker will go a long way to make the video clip, say about photosynthesis, more interesting for students.

- Interactive Whiteboard or Smart Boards

  These are the ‘presentation tools’ being widely used in the classrooms. Replacing the blackboard of the classroom, these offer the opportunity to share information with both large or small group of students. It allows the teacher to share the interface of a computer (i.e. computer screen) with students to present or share any information and even its manipulation. Text can be highlighted, focussed on with a pointer of the mouse or using fingers. The whiteboard can also be used as ‘blackboard’ by teachers to write.

- Webcams

  Webcams or web based cameras are used to send and receive pictures or videos through internet. It is a great tool for communication between teachers and students, especially in distance learning. Software like Skype can be used for communicating. Many messaging apps also boast of this feature and camera on a phone can also be used to exchange media as well as make video calls.

- Software Applications

  Courseware: The term is formed by combining the two terms ‘course’ and ‘ware’. These are used to provide additional material for the content taught in schools specifically designed to be used with computers. They are available in form of CDs or DVDs and recently, they are being offered through internet in form downloadable files or online. In recent times, companies are seen marketing ‘courseware’ as ‘packages’ which are focussed on providing content for a particular class or level with tests, lessons and other material required.

  Reference Software: These include different dictionaries or encyclopaedias in digital format. They are available on CDs or DVDs, often with multimedia content. These days, with advent of internet, this software have been replaced by Wikipedia, Wikitionary, etc.

  Open Course Ware: These are programs which provide students free access to information. May universities and organisations are a part of this consortium e.g. Harvard, Princeton, Stanford, etc.

  Learning Management System (LMS): It is a software application which is being used for delivering and managing education. It’s a handy tool for teachers and administrators as it helps them keep track of activities in schools. It can be used to keep track of student attendance, their performance, list of assignments and so on. On the basis of requirement of the institution students and their parents can also be made a part of this application. This platform can also act as a means of collaboration among different stakeholders using networking. **MOODLE** (Modular Object-Oriented Dynamic Learning Environment) is the most common open source software available for learning management systems.

  Learning Content Management System (LCMS): it is a similar application platform as LMS but is used exclusively to either host author’s content on a LMS or specifically for hosting content.

  Recent trends in kinds of ICT tools being used in education mostly involve use of networking through internet. The terms and concepts being popularised are

- Computer- supported collaborative learning (CSCL)

  As the term suggests the concept involves collaboration among students; it is similar to the concept of 'e-learning 2.0'. Collaboration is based on sharing of information among different stakeholders, it is different from the concept of traditional learning wherein only the teacher was in control of all the information and skills related to it. CSCL entails use of Blogs, Wikis, Google Docs, DropBox and other cloud based portals for sharing of information. Other related concepts are Web 2.0, Classroom 2.0 (Multi-User Virtual Environments, connecting classrooms across the world through networking/internet), E-learning 2.0 and Virtual Learning Environments (VLEs) and Personal Learning Environments (PLEs).

  Collaborative learning helps in sharing and discussing ideas and promote knowledge, using these tools will help our future generation of learners in incorporating 'technological skills' required for contributing to the 21st century knowledge based economy.

- Massively Open Online Courses (MOOCs)

  These provide open education through US- styled content and curriculum. It is a concept popular in developed countries. Through MOOCs it can be implied that emphasis on certain teaching methodology and content endangers the 'cultural and educational traditions' of lesser developed countries and would greatly influence the local institutions and try to create monopoly of educational system of developed countries like U.S. India has also forayed into this area with launching of **Swayam** which provides learning opportunities through free of cost courses available from class IX up to Post graduation level.

- Social Networking

  With almost everyone using their Facebook and/ or Twitter accounts to communicate or express themselves, it is important to tap the potential of such networking platforms. These are generally used for socialising, however, these resources can be tapped by teachers to make learning more engaging for students. For example: students can be asked to create a page for their class or on a particular topic in science or literature. Twitter can be used to follow

leaders and is a great resource of knowing the current events. Also, communicating on these platforms is easier for students and helps them in engaging in dialogue with people around the world involving several 'thinking skills' of reasoning or analysing situations.

- Blogs or Edublogs

  These are like personal journal entries but on internet. Since, they can be restricted to personal or public access, blogs can be used by teachers to share content while embedding different multimedia or links to other webpages. Students can also use it discuss or share their ideas and to collaborate with their peers.

- WebQuests

  These are lessons planned using various internet resources and promote development of higher order thinking skills of students. Simple webpages developed online form the lessons wherein the teacher has identified the sources and thus, the focus of the students is on the task identified rather than the information gathering. It works well in collaborative environments.

- Other important resources finding great use in education are: Google hosted services (Google+ for social networking, Google Docs and Drive for sharing, Google Scholar for searching for academic journals and resources), Wikipedia, E-mailing services (Gmail, Yahoo mail, Hot mail, etc.)

HIGHER ORDER THINKING SKILLS IN EDUCATION

"Perhaps most importantly in today's information age, thinking skills are viewed as crucial for educated persons to cope with a rapidly changing world. Many educators believe that specific knowledge will not be as important to tomorrow's workers and citizens as the ability to learn and make sense of new information."

D. Gough, 1991 (as cited in Cotton, 1991)

The purpose of education has been to help individuals to learn the ways of life, since time immemorial. If the pre historic humans taught their progeny to hunt, the humans

of the industrial age wanted to inculcate skills for earning livelihood by teaching their children mathematics for them to become clerks, handling machines so that they could work in factories and so on. The aim has always been to survive in the competitive world.

With the advent of computers, the scenario changed again- with stress on at least having basic skills or familiarisation of computers and related devices. However, with rapid advancements in this area and its effect on every other area, it became imperative that the future generation be not only familiar with computers but develop certain skills to stand up and take all the changes in their stride.

These skills are meant to help in life-long learning and adapting to the state of flux in the society. We often come across the mention of these skills as following terms:

- Problem solving skills
- Reasoning ability
- Critical thinking
- Creative thinking
- Higher order thinking
- Cognitive ability
- Metacognition, etc.

According to King, Goodson and Rohani (1998) higher order thinking processes are:

- Interlinked to learning, they cannot be studied as stand-alone components,
- These skills will develop and possibly be influenced by both school and community experiences
- These are influenced by multiple factors (both individual and social, school and home environments)

Theories related to thinking and learning processes try to describe the intricate process of thinking, some of them are described as following:

Dewey: He said that thinking happens when questions are posed; observations do not give solutions but suggest it. The process of finding the solutions leads to the process of thinking.

Piaget: Described the development of the cognition through certain stages related to age. Transition from childhood to adolescence would involve "operational thinking" and subsequent transition from adolescence to adulthood would lead to development of "logical use of symbols", "abstract concepts", "scientific reasoning" and "hypothesis testing". These skills form the ground work to development of 'problem solving', 'self-reflection' and 'critical reasoning' (Crowl et al, 1997; Miles, 1992 as cited in King, Goodson & Rohani, 1998).

Bruner: According to him, the development of cognition in not linear but is simultaneous. He introduced the concept of 'spiral curriculum' in which the information that learners have known before is linked to the new set of information.

Bloom: The taxonomy given by Bloom involves three areas of 'Cognitive, Affective and Psychomotor' skills. The basic skills or 'lower levels' of knowledge, understanding/ comprehension and application lead to 'higher levels' of cognition through analysis, synthesis and evaluation.

Glaser: Drawing upon concepts given by Dewey, Glaser described to think for problem solving involves a state of 'perceived difficulty' in order to generalize an idea or concept. The limited information given for problem solving will give limited answers and in order to generalize the issue, problem may be re-developed or re-visited. Thus, thinking is complex and will also develop on the basis of the attitude and habits of the learner or else the thinking process may steer in the wrong direction.

Marzano: Developing on work carried out by other researchers, he developed "Dimensions of Thinking". These describe the dimensions in 5 parts: Metacognition, Creative and Critical thinking, Thinking processes, Core Thinking Skills, Relationship of Content area knowledge to thinking, for each of these dimensions the concepts and skills have been identified. From Marzano's work on dimensions of thinking (1988), dimensions of learning were developed by McRel in 1997.

Vygotsky: The major concept of Vygotsky's cognitive development draws upon the concept of 'social interaction'. The role of peers, teachers, parents, community is

important as they guide children and contribute to development of their higher order thinking processes. “Zone of proximal development” helps the individual to move to higher level of mental functions when opportunities to interact are increased with assistance of “hints, questions, behaviour modelling, rewards, feedback, information giving, self-talk or peer tutoring” (Crowl, et al., 1997 as cited in King, Goodson and Rohani, 1998)

Haladyna: Describes the complex nature of thinking and learning after its classification in 4 levels: “understanding, problem solving, critical thinking and creativity” applied to four content types of “facts, concepts, principles and procedures” (Haladyna, 1997 as cited in King, Goodson and Rohani, 1998). This classification is quite similar to that given by Bloom, accounting for higher order thinking.

Pluralistic Intelligence: Gardner is associated with the concept of “multiple intelligences”, Guilford with “structure of intellect” and Sternberg with “tri-archic theory”. Certain abilities associated with different intelligences substitute types of thinking or problem solving or reasoning ability. Researches have shown that intelligence and higher order thinking are hard to distinguish (McPeck, 1990 as cited in King, Goodson & Rohani, 1998) because of the ‘multi categorical’ nature of problems; the problems are often interlinked and not domain specific.

Gardner: Howard Gardner’s Multiple Intelligences is drawn form in depth research on research findings from different areas which led to him developing certain criteria for identifying different intelligences. The 8 types of intelligences identified in his theory are- “Linguistic, Logical-Mathematical, Spatial, Musical, Naturalist, Bodily-Kinaesthetic, Interpersonal and Intrapersonal”. This theory relies on certain domains or disciplines in which an individual may demonstrate high level of intelligence. However, no data regarding the neuro-imaging or any psychometric technique which measures this intelligence of an individual directly is available yet (Davis et al). His multiple intelligence theory (1983) is often juxtaposed to the general theory of intelligence (two factor). The general theory is based on biological traits while the multiple theory is derived from skills and social situations of individuals.

Lewis and Smith (1993) describe Higher order thinking as:

"Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations. A variety of purposes can be achieved through higher order thinking…deciding what to believe; deciding what to do; creating a new idea, a new object, or an artistic expression; making a prediction; and solving a non-routine problem."

"Higher order thinking involves breaking down complex materials into parts, detecting relationships, combining new and familiar information creatively within limits set by the context, and combining and using all previous levels in evaluating and making judgements"

- King, Goodson and Rohani (1998)

Lauren Resnick as a chairperson of National Research Council (USA) for a working party on 'teaching thinking' concluded that *"higher order thinking is complex and effortful thinking that produces valued outcomes."* (as cited in Wegerif, 2006)

She claimed that this was not a 'mechanical' process however, it is easy to identify and hard to define.

Bloom's taxonomy, which is widely used in education states that to develop 'higher order thinking skills' one must be build the foundation of 'lower order thinking skills'. This fact is often contested as many claim that the process of 'thinking' or 'learning' cannot be hierarchical. Bruner proposed the concept of spiral curriculum on the basis that thinking cannot be hierarchical and is inter related.

The recent emphasis on 'higher order thinking' or 'thinking skills' or 'critical thinking' is embedded in our present socio-cultural context. These skills are described as the skills for 21st century, important for our future workforce. The changing dynamics of our present day economy is due to the advent of information and communications technology; these technologies have revolutionised the way we work, with increased 'automation' of our daily lives, we need to take more and more decisions; hence, the importance of the 'thinking skills'.

Limbach and Waugh (2010) in their paper "Developing higher level thinking" describe a 5 step process for developing Higher level thinking skills:

Step 1: Identifying learning objectives

Step 2: Questioning

Step 3: Practicing before evaluation/assessment

Step 4: Review, refine and improve

Step 5: Giving feedback and assessing the learning

In 1998 American Psychological Association (APA), outlined 'perspectives on learning' in a report- "Learner-Centered Psychological Principles: Guidelines for School Redesign and Reform" (in Presidential Task Force on Psychology in Education as cited in Kauchak and Eggen, 1998). The purpose of these principles is to guide teaching of thinking skills.

Since, 'learning is an individual activity' teachers need to use such strategies and techniques so that each student finds meaning in the classroom instruction. This can be achieved by creating student-centered environment in the classrooms. In this sort of environment, students can be easily motivated with direction from the teacher.

Many strategies can be used to inculcate higher order thinking in students. The teachers can help students by giving clearer instructions and communicate about what is expected of the students. By scaffolding the previous information to the concept being taught and relating to the real life situations the students will be to direct their thinking. Certain learning and thinking strategies can be employed by the teacher, direct instruction on tasks can also be given to the students. The questions teacher asks help in pointing students to the right direction. Encouraging team activities helps students to collaborate and open to other perspectives on the information being discussed in the task allotted to them, activities like student discussions, peer tutoring and co-operative learning can be used. Also, computers can be used to present content and aid in designing instruction and related to it, along with activities as well. There is a lot of literature available which describes how technology can be used in instruction and how it affects students learning.

ICT and Higher Order Thinking Skills

The 21st century schooling system needs technology not only to capture interest of the students but also understand the fact that how teachers can use technology to develop and inculcate higher order thinking skills and how these skills can be applied and help in understanding of all other key areas (State of Queensland, 2002; as cited in Lloyd, 2005).

Wegerif (2006) in his review in "Thinking skills, Technology and Learning" as a part of FutureLab Series describes 3 ways by which use of ICT can help support teaching and learning of thinking skills:

- The visual representation of information, or presenting the information in multiple ways, adds depth to the information and gives learners opportunities to think

  e.g. using graphs to present data and then, asking students to think and come up with more information about that data.
- Educational software not only acts as a source of information (like a teacher during instruction) but they can also be used to initiate discussions and exploring different ideas. These software if properly designed, can be used for 'direct instruction' or 'discovery learning'

  e.g. teaching a concept in science or mathematics and using the software to present a video clip or simulating the information.
- Networking with other learners help in initiating collaborative efforts which subsequently can lead to opportunities for 'knowledge creation'

Simply using ICT as a tutor, tool or as a support to initiate dialogue will not lead to acquiring of thinking skills (Wegerif, 2006; Lim, 2001). What is required is recognizing, modelling and application of these skills to other contexts, this where the role of the teacher becomes important.

The role of technology is often undermined particularly in the field of education. We often fail to realize that using of chalk on board or pen/pencil on paper is a tool and hence, part of technology. It is only that the prevalent face of technology for us has somehow limited itself to computers and such digital devices. In present scenario, the information/knowledge is handled by computer based technologies instead of books.

The importance of technology is that it is the carrier of information, we need "tools and tool-systems" as we cannot think on our own (Wegerif, 2006).

Both Vygotsky and Dewey recognised that thinking is a social construct. Vygotsky described language as "a tool which mediates the development of thought" (Salomon, 1993 as cited in Wegerif, 2006) and Dewey recognised the importance of social interaction in developing thinking (Dewey, 1933 as cited in Wegerif, 2006). Fisher (1998) in his approach 'Philosophy for Children', advocated using discussions and building the classroom as a community to support and teach thinking skills.

To understand how thinking develops, we need to think of it as a circular process (in a continuum). The environment around us provides stimuli, to 'internalise' what we observe and an opportunity to understand it, reason it or evaluate it (i.e. 'Individual thinking'). On sharing this information (obtained through stimuli; which an individual has internalised), during social interaction (through dialogue) after reasoning, evaluating the information and other present, one can observe 'thinking' happen. Thus, we can conclude that *"there is a constant movement of the internalisation of external thinking into individual thinking and externalisation out again by individuals who create and shape social thinking."* (as quoted in Wegerif, 2006)

Higher order thinking can be observed in an individual during the process of 'internalisation' and 'externalisation' of the information presented to him/her. Thus, "Thinking is both individual and social" (Wegerif, 2006). The importance of developing these higher order thinking skills can be understood when it has been claimed that the present elementary school population will be working in jobs out of which 65% don't even exist yet! (World Economic Forum, n.d.) With such demands on our building economy, it is advisable to not overlook the demands of the present and future generation and create opportunities to inculcate and develop higher order thinking skills in them. And what is more apt than using the technology which is to stay and evolve with passing time, for developing these skills?

"The most basic premise in the current thinking skills movement is the notion that students CAN learn to think better if schools concentrate on teaching them HOW to do so" (p. 17)

- Presseisen as quoted in Cotton, 1991.

Wegerif (2006) in his review of thinking skills, technology and learning outlines 3 ways through which ICT can be used to teach thinking skills to students in schools:

- As a "tutor"
- As a "mindtool"
- As support

As a tutor, computer acts a 'teaching machine' i.e. it directs the instruction of the material presented. The information is usually arranged on the basis of easy/basic level to difficult/higher level. The advantage is that it provides immediate feedback to the student but it limits the conversation among peers. Since, the instructions are directed by the machine, learner has no opportunity to 'think and make connections' between the information presented. Thus, this method can be considered a proponent of Behaviourist tradition (because of the stimulus coming from external environment, controlled by the teacher through 'teaching machines').

As mindtool, computer acts a 'modelling' environment. They are computer applications which when used to present the information, they help in engaging learners in critical evaluation or thinking about it. For designing and developing such educational applications, 'constructivism' is the main paradigm. The idea is to work with computers, students will acquire or develop certain strategies while working and may develop thinking skills often without consciously being aware of them.

As a support, computer can contribute by creating interactive learning environments. While using them as a tutor or a tool, we direct the learning but using it as a resource for support, computer helps in communicating knowledge or information. Technology acts as a carrier of 'thinking skills' as its usage becomes akin to the 'socio-cultural' model of learning.

It is imperative to state, that no matter how computer or technology is being used in the classroom or for whatever purpose (tutor, tool, support), the success depends on a very important factor on how it is being 'framed'. The learners need to be aware of what they are working towards, the tasks need to be modelled, made explicit and be applied to other contexts as well.

Uses of computers as Tutor:

- Intelligent tutoring systems

Use as mind tools:

- Programming
- Visualisation and simulation
- Concept mapping
- Hyper text
- Hyper media
- Computer games (g-learning)

Uses as Support for learning conversations

- Collaborative learning
- Conferencing
- Internet
- Shared databases

The important considerations for using ICT to transfer thinking skills are:

- Explaining students what they are to learn
- Modelling the task
- Giving prompt feedback
- Giving support in early stages to encourage autonomy at a later stage
- Encouraging dialogue and brain storming about ideas
- Helping understand that the use of skills in one context can be used in another as well

NEED FOR THE STUDY

Involvement of ICT in our lives has brought changes in communities across the world. The new active participants in this revolution are governments and education sector. To emerge as a fore runner among the knowledge based economies, any country needs ICT for quality education. Computers are 'ubiquitous', influencing our work, social and leisure lives as well. Since, more and more tasks involve human-

computer interaction, computer competency (skills and knowledge) is positively correlated to occupational as well as personal success (Teo, 2008).

E-readiness can be understood as the ability to use ICT in development of our economy and for fostering one's welfare. World Economic Forum in its report on Network Readiness Index (ranking of countries across world that gives the data that helps in assessing impact of ICT) placed India at 91st rank (out of 139 countries) in its Global Information Technology Report 2016. India was ranked 89th in the report of year 2015. The top 10 economies for 2016 were Singapore (1st), Finland (2nd), Sweden (3rd), Norway (4th), United States (5th), the Netherlands (6th), and Switzerland (7th), U.K. (8th), Luxembourg (9th) and Japan (10th). India was also at the lowest ranking among BRICS with China at 59th rank, Russia at 41st, South Africa at 65th and Brazil at 72nd rank. The report issued by World Economic Forum mentions that the cause for drop in India's rankings is that other countries are moving at a faster pace than India. There is a deep divide between metros and rural areas of the country in terms of literacy, skills and infrastructure. These are the major areas which require improvement.

Countries across the world are investing in acquiring ICT resources every year, but there is little evidence on whether these technological resources are cost effective or if they are being used effectively, to face educational challenges, in particular. Since this investment is related to economy on whole, integration of ICT in schools (educational sector) needs careful consideration. Integration of ICT in any education system helps us to build confidence in our present as well as future learners. The ICT competency of our learners will go a long way in helping them to adjust and adapt to the changing digital economy and they will become contributors to this economy as the workforce.

To succeed and to be able to contribute to the technology skilled workforce, students must master ICT skills (Wheelwright, 1999 as cited in Steketee, 2005). In Indian context, National Curriculum Framework (2005) focuses on child as an 'active learner'. Education becomes irrelevant unless the gap between how students live and how they learn is bridged. In 2012, a draft of National Policy for ICT in Schools was framed by MHRD. The draft outlines the basic infrastructure that needs to be made available in schools along with training that would be needed to provide to in-service teachers and school heads for utilizing digital resources for various aspects of

teaching and disseminating materials across the country. However, no action has been taken till date for implementation of this policy.

With information having a short life day after day, education should empower the learners to learn themselves and to be able to do so continuously. The key learning skills of the future: Interpersonal Skills, Information Skills, Technology Skills, Basic Skills, Thinking Skills and Learnability (Prakash, 2008) are needed to be successful. Learners need to master skills of decision making, prioritising, strategizing, collaboration and problem solving. And to survive in the competitive business world, organizations need that all the available talent is harnessed to ensure more productivity, innovation and creativity.

Schools need to prepare students who have the capability of adapting to the changing nature of technology and have a set of basic digital literacy skills (Leu et all, 2013). Thinking Skills are being described as 'skills for new century' or 'skills for the knowledge society'. The economy requires workers who have to take 'subtle decisions and solve more complex problems' (Levin and Rumberger, 1995), thus, the focus of education should be to inculcate (and develop) these skills in students to make them more inept for contributing to the economy of the fast changing world.

Policy makers and educationists across the world are placing more emphasis on higher order thinking skills, of which *critical and creative thinking* are considered key components (Harlen, W. and Deakin, C. R., 2003). In India, Central Board of Secondary Education, New Delhi has also emphasised on development of higher order thinking skills (HOTS) with questions based on "analysis, evaluation and synthesis" (Bloom's taxonomy, 1956) becoming a feature of exam questions.

Complex real life problems often demand complex solutions, which can be attained through development of higher order thinking processes. Teaching and developing these skills will provide students with relevant life-skills and offer them the benefit of helping them improve their content knowledge, lower order thinking and self-esteem. Since, ICT has become an integral part of our lives and will continue to be so, it is only logical to teach higher order thinking skills through the real-world context. With internet fast becoming invasive in our social and personal lives, it is more efficient and logical method. Using computers as 'tutors' can be an effective way by which 'thinking skills' can be infused in a subject area. "*With the right teacher input and*

software design group work around computers can turn the use of reasoning skills into learning outcomes" (Wegerif, 2006). When ICT is integrated in 'high quality learning environment', researchers have demonstrated that it can help "*deepen student's content knowledge, engage them in constructing their own knowledge, and support the development of complex thinking skills*" (Kozma, 2005; Kulik, 2003; Webb and Cox, 2004).

In the end, we need to understand that integration of ICT in any school or educational system requires an overhauling of the existing structure. Availability and proper usage of these ICT tools are one of the major concerns for a developing country like India. Skills, attitude and availability of resources to both students and teachers determine their adaptation of these tools in the teaching and learning process. For development of higher order thinking processes, certain strategies need to be followed as simply using ICT tools will not help in inculcating these skills in students. Teachers play a major role in deciding how they use these technological tools to supplement their teaching. These tools may be used for planning and structuring lessons, selecting resources, guiding activities in classroom or for supporting the content. For significant changes to take place in classrooms teachers need to focus on changing their pedagogy through use of ICT (Scrimshaw, 1997). To improve learning in schools, improvement in teacher's knowledge of subject matter, ICT skills and ICT skills related to a teaching of a particular subject matter is also the requirement. To ensure long term innovations in education, skills of using technology should be maintained to keep up with the changing technologies; this can be ensured by timely training of teachers and providing them constant guidance and support.

RESEARCH QUESTIONS

- How is ICT being used by students and teachers in the teaching and learning context?
- Is integration of ICT affecting Higher order thinking skills of students?

TITLE OF THE STUDY

A Study of Integration of ICT and its Influence on Higher Order Thinking Skills of Secondary School Students

OPERATIONAL DEFINITIONS

In the present context of the study undertaken, following key terms have been defined (with their scope limited to) as:

ICT (Information and communication technologies): "*Computer based tools used by people to work with information and communication processing needs of an organisation. It entails computer hardware and software, the network, and other digital devices like video, audio, camera and which help in converting information such as text, sound, motion, etc. in digital form"* (as defined by Moursound and Bielefeldt, 1999).

The draft National Policy of ICT in School Education (2012) policy also defines ICT similar to the definition above in the context of education, highlighting the accessibility of resources, creation of digital interactive content and managing both learning and administrative tasks through these tools. The schools which will be taken in the sample shall be assessed in terms of availability of ICT tools as per the norms given in the draft policy (2012).Thus, the ICT tools for this study include use of interactive/ smart boards and computers with internet in classroom.

Higher Order Thinking Skills (HOTS):"Higher order thinking involves breaking down complex materials into parts, detecting relationships, combining new and familiar information creatively within limits set by the context, and combining and using all previous levels in evaluating and making judgements" (King, Goodson and Rohani, 1998)

In the present study, keeping the context of teaching-learning in sight, higher order thinking skills will be limited to the processes of "reasoning, analysis, evaluation and synthesis" (Bloom's taxonomy, 1956).

OBJECTIVES

1. To study the usage of ICT by students and teachers in school.
2. To examine the ways ICT is being integrated in teaching and learning process of different schools subjects at secondary level.
3. To assess the higher order thinking skills of secondary school students.
4. To observe relation (if any) between higher order thinking skills and I.Q. of secondary school students.
5. To observe (if any) integration of ICT in teaching and learning is influencing higher order thinking skills of secondary school students.

TOOLS AND TECHNIQUES

The tools to be used for collecting data will include a tool to assess availability of ICT tools in schools along with a questionnaire for both teachers and students to know about their usage of ICT tools for the teaching and learning process. A tool to assess student's IQ and higher order thinking skills will also be used.

SAMPLE

The sample of the present study will comprise students and teachers from secondary schools of Delhi (affiliated to C.B.S.E.).

ANALYSIS OF DATA

The data obtained will be analysed using both Quantitative and Qualitative methods.

DELIMITATIONS

1. The ‘integration of ICT’ will be limited to the teaching and learning process in the classroom/ school environment.
2. The schools using ICT are akin to school using Smart boards for teaching in schools.
3. HOTS have been defined as in Bloom’s taxonomy 1956.
4. The population for the research is secondary schools of Delhi only.