Chapter 16
Information and Communication Technologies in Education: A Framework for Transforming the Indian Education System through Smart Learning

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Abstract Literate and educationally advanced population is the primary characterizing feature of any developed nation. In this context, digital inclusion in education system is seen as a potent solution to the holistic growth of an education system, since it provides a comfortable learning environment that meets the demands of individual learners, and that of the society as a whole. Like many other governments around the world, the Government of India has also made strides in modernizing its education system by promoting Information and Communication Technology (ICT)-based education. Educational institutions support this innovative technology-based education system, known as "Smart Learning". The current chapter focuses on ICT's required capabilities in establishing a digital environment and examines how ICT may upgrade education for next generation, while also being effective in smart learning. The study further emphasizes the opportunities and benefits of ICT in the education system, and throws light on a few important initiatives taken by the Indian Government and other organizations toward the holistic development of the Indian education system by bringing sophistication in the field of education. This work can be categorized as descriptive research. Researchers have chosen a qualitative method by reviewing and analyzing reports, research works, and other information sources pertaining to the topic. Thematic and Content Analyses are used to infer from the data acquired from various reports, reviews, and also from experts'

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opinions. The challenges that pose impediments in the path of successful implementation of the ICT-based teaching-learning system in India are also dealt with. Findings of this study will provide guidance to educational policymakers as well as future researchers of the country.

Keywords ICT · Digital literacy · Smart Learning · E-learning · Indian Education System

1   Introduction

Education is the engine that propels the socio-economic progress of any nation (Hanushek & Woessmann, 2011). In a broader sense, education improves people's living standards, which benefits both individuals and society. A country's development goals can be met only through educational progress. The constitution of India ensures equal access to education for all its citizens irrespective of their caste, creed, gender, and religion. Knowledge is at the heart of today's society. With the explosion of knowledge, the quality of education has now become a serious challenge for education experts, planners, and policymakers.

The definition and meaning of "education" and "knowledge" have evolved over time. People in the era of technology now have new perspectives on these terms. In this digital era, technological advancement has rendered civilization reliant on technology. Terms like "educational-technology", "audio-visual classroom", "smart class", "virtual class", "digital library", "online learning", etc., are now being frequently used. With the rapid development in communication technology, the usage of ICT in various fields, particularly in the education sector, has soared to new heights. This growth of new inventions in multimedia technologies, improvement of Internet connectivity, and its widespread application have brought a revolution in the field of communication and education in the last few decades. As the potentiality of ICT is increasing day by day, it is becoming more relevant, and simultaneously upgrading the quality of education in developing nations (Tinio, 2002). It is, therefore, not farfetched to say that the application of ICT has reformed the entire education system at a global level (Watson, 2001).

In India, education is primarily focused on increasing access to education, fostering self-directed and lifelong learning, and implementing new techniques to deliver education (Vasudevaiah, 2016). Although India's literacy rate has increased in recent years, the country is yet to cater to all the residents, particularly those in rural areas, the kind of education that the current situation demands. The introduction of communication technology has made it very clear that technology can be used for formal and non-formal education, teaching, and learning even at higher levels.

Application of ICT in teaching and learning can provide more opportunities for teachers, students, and researchers to work better, and thus ICT can strengthen the Indian education system.

The present study focuses on the requisite capability of ICT in creating a digital environment and discusses how ICT can transform education for the next generation and can be effective for smart learning. Researchers also highlight the prospects and benefits of ICT in the education system, as well as few initiatives taken by the Government of India and other organizations to advance the country's education system. The promising practices in ICT adoption are specially highlighted. This research work also addresses the challenges that stand in the way of successful implementation of an ICT-based teaching-learning system in India.

2   Objective of the Study

This research study revolves around few key objectives. The first objective is to conceptualize the idea of Information and Communication Technology (ICT) and its scope in the education sector. The second objective focuses on ICT's potential to create a digital environment, and the numerous benefits of ICT in education and training sectors. The third objective is to investigate the role of Information and Communication Technology (ICT) in the education sector, particularly in higher education and also in "smart learning". The fourth objective of this chapter is to highlight a few key initiatives taken by the Indian government and other organizations in recent years to improve the overall development of the Indian education system by bringing sophistication to the field of education in recent times. The fifth objective deals with problems that stand in the way of the successful implementation of an ICT-based teaching-learning system in India and makes recommendations for better ICT implementation in the growth of India's educational system.

3   Methodology

This study can be categorized as conceptual research. Researchers have chosen a qualitative method by reviewing and analyzing media reports, published works, research papers, working papers on Information and Communication Technology (ICT), and the Indian education system. Apart from this, researchers also got inputs from academicians and other education experts to know their perspectives on ICT's ability to create a digital environment, its benefits in education and training sectors, and common challenges of implementing an ICT-based teaching-learning system in India. Finally, thematic and content analysis has been applied to scrutinize and infer the data acquired from various reports, reviews, and experts' opinions.

4   ICT: Definitions and Meaning

The term "ICT", which is commonly used nowadays, stands for "information and communication technologies". Communication technology can be described as the process of sending, receiving, and exchanging information. "ICT" has been explained in many ways. ICT comprises all electronic equipment, tools, resources, and services that can be converted into or delivered through digital forms. UNESCO in 2002 defines ICT as the combination of information technology with additional technologies, specifically, communication technology (Anderson et al., 2002). Biswas (2019) addresses ICT as technologies and computer programs; those are mainly used to access, save, organize, retrieve, and present the data through an electronic mode. ICT in education refers to a technology-based teaching-learning system and computer-based communication that governs the entire learning process (Ghavifeker & Rosdy, 2015).

5   Scope of ICT in the Education Sector

Nowadays, the computer-aided teaching and learning process has become popular. Using ICT technologies, one may even encourage and enhance the learning process. ICT can be used as a means of engagement, a source of knowledge, and a medium for knowledge transfer. ICT offers a broad range of applications and has the potential to play an important role in the education sector. Students in rural schools can easily understand the content if it is presented in their native language, and by using ICT technologies, their language of communication can be further developed, which is the biggest obstacle to rural people in the case of receiving modern education. Apart from all the schemes launched by the government regarding educational development, the ICT scheme has now become inevitable. The Government of India (GoI) has declared the period from 2010 to 2020 as the decade of innovation with ICT-enabled education and adoption of ICT skills for students.

6   Capability of ICT in Creating a Digital Environment

ICT-enabled teaching-learning process encompasses a variety of tools, approaches, and technologies that enhance the quality and efficiency of the teaching-learning process. There are numerous ways to use ICT tools in a classroom. A regular classroom can be transformed into an ICT-enabled classroom with widespread usage of teaching-learning technology. Even in informal education, new media provides a wealth of information in a range of formats. On YouTube, people can share their

knowledge and tips. Teachers can disseminate free YouTube tutorials and text-based learning resources. In the instructional process, some media technologies can be employed. A teacher can deliver his/her lesson effectively in a well-known classroom with the help of those media and materials. ICT is basically access to technology. Computers can be placed in classrooms to maximize the opportunities for curriculum activity (Kennewell et al., 2000).

E-learning

Learning over the Internet, using digital media tools and digital information processing, is referred to as e-learning. E-learning is a method of education that is mostly dependent on electronic devices and Internet connectivity. For learners, e-learning eradicates geographical barriers. One can obtain a variety of e-materials from websites. E-learning allows students to gain knowledge while staying at home. Information technology is the sole practical means of reaching out to the world's students and providing education as a service (Bhattacharya & Sharma, 2007). Gunjan (2014) has mentioned some e-learning tools which are successfully running in the field of higher studies such as: Web Blogs, Podcast, Wiki, and Instant Messaging Apps like G-Talk, Messenger, Skype, Text Chats, and Internet Forums. It is important to understand that technology is merely an enabler of education in e-learning. It does not replace the value of educational content or pedagogy.

Open and Distance Learning

The open and distance learning system is defined by the Commonwealth of Learning as a method of providing learning opportunities that are characterized by the separation of teacher and learner in time or place, or both; learning that is certified in some way by an institution or agency; use of a variety of media, including print and electronic; two-way communications that allow learners and tutors to interact; the possibility of occasional face-to-face meetings; and the use of various media, including print and electronic (Source: Commonwealth of Learning, "An Introduction to Open and Distance Learning", 2000). ICT provides open and distance learning opportunities for students who have dropped out of school and are unable to complete their formal education in a traditional set up. It allows individuals to enroll in their desired course and continue studying, accessing study materials, submitting assignments, and conversing with mentors. In this process, digital libraries, e-books, online publications, etc., can be accessed by the learners. Ultimately it benefits distant learners. Realizing the effectiveness of ICT in Open and Distance learning; now India's educational strategies have also prioritized the use of ICT in its distance learning education programs in order to improve human resource development and extend access to education at all levels. With the help of ICT, thousands of people from most remote corners of the country can easily access education through distance learning.

7 Benefits of ICT in Education

As students have smooth access to information in this digital age, there is an increasing demand for research work, critical thinking, and skills. Students need to apply that knowledge in right place (George, 2017). ICT supports learners with special needs too (Moore & Kearsley, 2012). There are various software applications like excel, databases, etc., which are helpful in learning. Different software applications help the learners in learning and understanding the subject and also help them in developing a problem-solving approach. Computer technology helps the learners with high-order thinking (McMahon, 2009). ICT expedites the collaborative and constructive approach to learning activities of pupils which enhances their performance. Here, Table 16.1 displays various benefits of ICT in education from theoretical aspects given by different scholars.

8 Role of ICT in Education

Importance of ICT in the educational sector is increasing day by day. ICTs in school education aim to prepare students for long-term survival and expansion of a knowledge society, which in turn accelerates the country's overall socio-economic development. Education makes a clear path for a person, which adds value to his/her socio-economic and political mobility (Amutabi & Oketch, 2003). ICT has been used in education since its foundation; but its widespread presence has never been seen (Hepp et al., 2004).The Internet is the main tool for e-learning. With the help of the Internet and the web system, ICT extends the e-learning system. ICT consists of components like cyber infrastructure, online libraries, and online learning technologies; all are connecting stakeholders and making a new digital identity of pupils in the field of education (Chandra & Patkar, 2007).

ICT-based education can provide reliability, validity, and efficiency in data collection and make analysis process, evaluation, and interpretation easier at any educational level (Mooij, 2007). Teaching through the Internet with the help of multimedia makes the classroom virtual which comes closer to offline classes, it is like tele-teaching, and the whole learning process becomes interactive (Sampath et al., 2007). There are options like the World Wide Web WWW), teleconferencing, and multi-media-based self-learning through which the teaching-learning process can be handled.

Gurumurthy and Vishwanath (2010) conducted a study on computer-aided learning program (CAL) in Indian states Kerala and Karnataka. This study was based on the theoretical exploration and policy reviews. The study findings reveal that digital technology has the capability to construct local knowledge and also support audio-visual applications and text modes.

ICT extends more opportunities in formal as well as non-formal education. According to the International Institute for Communication and Development

Table 16.1 Benefits of ICT in education from theoretical aspects

Scholar Name	Benefits of ICT in education from theoretical aspects
UNESCO (2003)	Educational system of Asia-Pacific region makes extensive use of ICT, much like other parts of the world. Many believe that ICT will provide teachers more control, shifting emphasis of teaching and learning, away from being largely teacher-dominated toward student-centered activities. It is also expected that ICT would offer students the opportunity to enhance their creativity, problem-solving abilities, and other higher-order thinking skills, thus improving the caliber of students' learning
Razak and Embi (2004)	The scholars have put up a framework for ICT competency for English language teachers in Malaysia. Three levels of competencies such as (1) beginner, (2) moderate, and (3) advanced are suggested. It also consists of four additional components: (1) basic computer knowledge and operation skills, (2) teaching and learning skills, (3) planning and managing computer-based environments, and (4) assessment and evaluation. Authors have claimed that this framework could be beneficial to teachers
Nyvang (2006)	He has proposed a theoretical framework for "ICT application in higher education", based on "Activity Theory" and a "Case Study" conducted at a Danish University. Three processes that make up his model are selection and adaptation of ICT, and change and practice with ICT.
Kabouridis (2008)	He opines as ICT has been tried and proven in underdeveloped nations for managing challenges related to teaching-learning process; it might therefore be successfully incorporated into the Indian educational system to teach a variety of disciplines, including mathematics, science, and engineering
Koehler and Mishra (2009)	Authors proposed a model named technological pedagogical content knowledge (TPACK) which refers to the types of knowledge required by a teacher for successful technology integration. This model focuses on the linkage between teachers' content knowledge, pedagogy and technological competency to promote effective teaching. Seven components of TPACK are divided into three main components. They are content knowledge (CK), pedagogical knowledge (PK), and technology knowledge (TK), which are considered as core competencies. Pedagogical content knowledge (PCK), technical pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK) are the products of interaction between those three components. TPACK can be used effectively in "integration of ICT in teaching learning" (IITL)
Metbe et al. (2011)	In their study, academicians have promoted the use of ICT in education systems, and to bolster their argument, they have highlighted how University of Dar es Salaam—a public university of Tanzania in East Africa—Has successfully implemented technology to enhance its educational and instructional practices
Ndibalema (2014)	He conducted a study on Tanzanian school teachers' attitudes toward using ICT as a "pedagogical instrument" and discovered that the teachers had a positive opinion on the technology

Table 16.1 (continued)

Scholar Name	Benefits of ICT in education from theoretical aspects
Luhamya et al. (2017)	The study tried to examine ICT integration in teaching-learning in a teacher training college in Tanzania. The author took integration of ICT in teaching learning (IITL) as the main variable which was measured by the SAMR Model, that is, substitution (S), augmentation (A), modification (M), and redefinition (R) (Lubega et al., 2014). The study proposes that through the "theory of planned behavior (TPB)", IITL of a teacher educator's can be explained
Ratheeswari (2018)	In her scholarly article, she has advocated that the quality of instruction will be naturally improved when using technologies like teleconferencing, audio-video conferencing, internet, e-modules, etc., in teaching and training processes
Lowoga and komba (2015), Awwadand Al-Majali (2015), Yakubu and Dasuki (2018)	Using the "Unified Theory of Acceptance and Use of Technology" (UTAUT) model, studies showed that student's "performance expectancy" and "effort expectancy" is related to their behavioral intention to use ICT. The UTAUT model explains the behavioral intention of users to use technology (Venkatesh et al., 2003)
Buabeng-Andoh (2019)	According to him, successful integration of ICT into the teaching-learning process has elevated to the top of the priority list for many organizations and governments worldwide after realizing the importance of ICT in learning and education
Dhingra (2022)	He talks about the interactive classes, where teachers and students work more closely together. According to him, with the use of various assessment tools and software, teachers can set up online assessments and quizzes to monitor students' progress

(IICD), ICT provides better quality of education for all. ICT can make better content and develop supportive administrative procedures in educational institutes which increase the accessibility of education for students and teachers both through distance learning (Gunjan, 2014). Now-a-days integration of ICTs in schools has become more important as technology helps students to learn in a better way (Ghavifeker & Rosdy, 2015). ICT improves teaching-learning methods by developing educational tools that provide motivation to learners and they can learn basic skills easily with the help of modern instructional technology which promotes their competency and quality.

8.1 Role of ICT in Higher Education

In today's world, everyone requires a minimum education to function as social beings, and this is non-negotiable (Khatun et al., 2021). In the past, learning and teaching relied solely on textbooks, but now ICT has opened doors to a wide range of study materials. ICT improves educational accessibility. Learners can get information on anything at any time and from any location. The process of learning has changed. It is quite beneficial in higher education. Students can obtain information

from e-books, websites, and online data by using technological devices. They can test and prepare themselves by taking online mock tests, model question papers, previous year question papers, and so on. They can also improve their knowledge by accessing online data, current events, current affairs, etc. There are many publications, research papers, and journals available online, and users can also contact resource people, experts, and researchers. People can communicate and meet with one another over the Internet. Teachers, students, professors, and academicians throughout the world have access to digital resources such as online libraries. Some universities, such as Terbuka University in Indonesia and IGNOU in India, have made extensive use of radio and television networks for both direct instruction and school broadcasting. The University of Air in Japan began broadcasting courses on radio and television in 2000. For each course, 45-min lectures were televised. Students were also given additional printed study materials and online tutorials (Iwanaga, 2000). In this regard, Narashimhan (2000) states that educational technology is essential for students in higher education to provide updated knowledge about their discipline as well as soft skills such as oral and content presentation, teamwork, time and conflict management, producing technical reports, and so on.

For any country's progress, a highly educated population is essential. Higher qualifications provide advantages in various areas of life for an individual. Teachers, professors, economists, politicians, and academicians all play an important role in the growth of the country. Higher education, according to Singh (2011), is crucial for developing future leaders in various domains, including cultural, economic, political, scientific, and technological. With the use of ICT, the quality of higher education can be improved. Jayasubramanian et al. (2015) researched on ICT awareness, access, and its usage. A survey among students of 60 colleges was conducted for the study to determine the satisfaction levels and preferences about ICT-enabled classes. According to the findings, students prefer ICT-enabled lessons because they are more participatory, appealing, and instructive than traditional lectures. The authors concluded that an ICT-enabled teaching-learning system had improved students' confidence, updated skills, and intelligence. According to several studies, ICT has a vital influence on education. As a result, the teaching and learning process is always evolving, and ICT is becoming increasingly useful in higher education.

8.2   Role of ICT in Smart Learning

With the advancement of digital technologies, the term "smart education" becomes common nationwide. A smart education system creates a smart learning environment for learners. It improves the quality of learning and extensively promotes thinking abilities, intelligence, and the digital literacy of the learners through seamless learning. According to Gawk (2010), smart learning is an effective and tailored learning which emphasizes content and learners and is mainly based on advanced IT configuration. This learning concept does not just depend on utilization of devices. It is a

learner-centered and service-oriented approach that amalgamates ubiquitous and social learning (Kim et al., 2013). A smart learning environment helps learners to access digital resources without the bondage of time and place as well as provides them useful tools and techniques and directions at the right time and place (Hwang, 2014). Middleton (2015) talked about the benefit of smart technologies in smart learning processes. This engages students in learning which increases learners' independency. Koper (2014) opined that a smart learning environment refers to an environment that is saturated with context-aware, digital devices for quality and fast learning.

In Singapore, a smart and student-oriented environment has been created to nurture the learning activities and fulfill several requirements of learners with the help of ICT (Education and Learning Sub-Committee, 2007). In North China, a pilot project named "Flipped Classroom" was executed in a middle school with the idea of smart pedagogies (Tucker, 2012, p. 82–83). Instructions by teachers usually happen in classrooms, but now it happened at home through videos made by teachers in this project. It was started with four classes initially but later all classes were included in the project. The purpose of the project was to develop self-regulated collaborative learning capabilities among school students. The project was designed with two phases: "*self-regulated questioning*" and "*practice showing*". All the students used tablet PC in their learning. The result of the study revealed that the learning capacity and consciousness of problems of students had improved. Teachers of that school started giving importance to personal learning of students and their professional required skills were upgraded and the level of education of the school was overall enhanced.

Countries like Korea, the United Arab Emirates, and Singapore initiated smart education projects for the development of their education system. These countries proposed world-class teaching-learning environments using advanced digital technologies. It aimed to encourage students to engage more in learning and develop critical, creative, and innovative thinking. It developed digital literacy among teachers and students. Smart technologies make them technologically equipped, expert, active, and competent (Zhu et al., 2016). In that case, it can be said that this type of project is likely to be successful in India as well. The Indian education system can be further improved. Although some efforts have already been made in India, they are lagging behind due to some obstacles.

8.3   *Teachers with ICT Competency in Smart Education*

In this age of change, new discoveries are being made in the field of technology every day; in this case, teachers also need to have knowledge of modern technologies. Knowledge of modern technologies will help the teachers in teaching students and make them understand the content clearly. ICT supports both students and teachers in the process of effective learning with the help of learning aids like computers, etc. (Jorge et al., 2003). The role of the teacher has changed with the spread of ICT and more will come in the coming days. A teacher of tomorrow, with the

knowledge and competence of ICT, would design a lesson plan and content presentation technologically. He/she can deliver lectures with the help of advanced ICT tools which will help the pupils. Hence, teachers need to be trained and ICT equipped. A teacher must have knowledge of technology for skill and professional development. Inclusion of ICT in teacher education has become essential.

Application of ICT in education is successful when teachers are skilled and empowered through ICT. It does not depend upon the advanced software, it depends upon how a teacher can be influenced and empowered by ICT to use those advanced hardware and software, observed Yuen et al. (2003). If necessary arrangements, equipment, and technological support are provided to the teachers, and they are able to develop ICT classes and can change and formulate the course structure and format assignments for students (Watts-Taffe et al., 2003). According to Lau and Sim (2008), ICT promotes learning deeply and teachers can fulfill various academic needs of different learners at any level. A teacher should learn how to use modern technology at the time of teaching in classrooms and he/she should learn from the student's perspective, how technology can be integrated with classroom activities to enhance learning (Tezci, 2011). Therefore, to further engage students in classroom activities and develop effective lessons for the students, teachers have to use ICT in a productive manner with creative thinking (Honan 2008; Birch & Irvine, 2009). Integration of technology in pre-service teacher courses enables teachers to learn how to use technological tools in the enhancement of their teaching quality and the learning of students (Chai et al., 2010).

8.4 Learner-Centric Aspect of ICT in Smart Learning

Educational technologies help learners to demonstrate their new ideas, explain their thoughts, and transfer information in a learning environment. ICT promotes a constructive approach to learning activities. Students get opportunities to make contact with teachers and other students and also have a conversation. They can access various sources of information. With collaborative learning, learners can deal with issues, and decode and resolve them (Gredler, 2000; El-Amin & George, 2020). Few skills and abilities which should be developed by the students through which they can gather information using the Internet, synthesize them, and can draw inferences (Sampath et al., 2007). The skills include basic knowledge of computers, multimedia software, Internet, net surfing techniques, storing and retrieving data, and communication with other persons. ICT can provide creative learning (Fu, 2013), and it develops new understanding among students (Chai et al., 2010). ICT helps to develop skills of critical thinking among students (McMahon, 2009; Fu, 2013). ICT offers collaborative learning, students can work together which enhances their learning capacity (Rodrigues, 2002; Suryani, 2010). Rodrigues (2002) says that effective learning happens when students are interactively engaged in a learning task.

9   ICT in India

For many years, India has used technology in education under the moniker of education technology. Computers, radio, television, and telephone are examples of educational technology. With the advancement of new breakthroughs and advanced technology, a new term ICT (Information Communication Technology) emerged. The Internet is a crucial communication technology tool. The Internet has been used in India for a long time, and it was first identified as ERNET (Educational Research Network), observed Sampath et al. (2007). It was not available for the general public, because it was created solely for educational reasons and was only available to educational research communities. In 1975, the Kerala government, in partnership with AIR Trivandrum, launched a radio-cum-correspondence program for teachers. It was a professional development program for in-service teachers. The "Teach English" program for primary school teachers was launched in 1976 by AIR Ahmedabad in partnership with State Institute of Education (SIE), Ahmedabad, and H. M. Patel Institute of English, Vidyanagar. AIR Madras began airing two programs per month on various topics such as science, history, mathematics, geography, education technology, and so forth. As a result, AIR Pune began broadcasting programs to assist unskilled elementary school teachers with the assistance of the state (Goel & Jaiswal, 2000).

With the expansion of television networks, more educational programs were introduced. ETV programs for students aged 5–8 years and 9–11 years and also for school teachers were launched by the Central Institute of Education Technology (CIET) and National Council of Educational Research and Training (NCERT). There was a University Grant Commission (UGC)-sponsored program named Country Wide Classroom (CWCR) for university students which was telecasted in 1984. To study the effectiveness of CWCR, the "talkback" program was conducted by UGC and ISRO from November 25–30, 1991. Eight centers in total were selected for that program. Out of eight, two centers in Jodhpur and Imphal were connected through the Delhi studio and the other six centers were connected through a telephone network (Goel & Jaiswal, 2000).

A Few More Instances of ICT Initiatives in India
- An experiment program named SITE was launched in India in the year 1975–1976. The purpose of the program was to broadcast educational programs in 2400 villages in India. The experiment was done through the distribution of 500 television sets in villages. States like Andhra Pradesh, Rajasthan, Karnataka, Gujarat, Odisha, etc., were selected. Television programs were telecast for rural students of class I to class IV.
- EDUSAT is the satellite that was launched in 2004 by ISRO to meet the demands of the educational sector focusing on distance education. The INSAT satellite was launched in 1981 to telecast educational programs.
- IIT Kanpur has launched an online platform called "Brihaspati". It was developed by the education and technology research group of IIT Kanpur. This

platform was created to enhance learning through learning, discussing, and sharing study material online (Bhattacharya & Sharma, 2007).
- The National Program for Technology-Enhanced Learning (NPTEL) project was started by Ministry of Human Resource and Development (MHRD) in 2003 to provide quality education in engineering. Some video courses and e-courses were developed. The program was launched by the joint collaboration of seven IITs (Indian Institute of Technology) of Delhi, Madras, Mumbai, Roorkee, Kharagpur, Guwahati, Kanpur and Indian Institute of Science (IISC) Bangalore.
- From 2005, to create an ICT lab in all government schools, the Government of India started the ICT program "BOOT" (Build Own Operate Transfer).
- In 2007, the Centre for Distance Engineering Education Program (CDEEP) was launched by IIT Mumbai. Under this program, interactive classrooms were created through interactive satellite technology.
- In 2012, the UP government launched the "free laptop distribution scheme." Under this scheme, free laptops were given to high school and intermediate pass out students to encourage them toward higher studies.
- ICT initiatives such as E-Gyankosh, GyanDarshan, GyanVani, and various other distance education programs have also been launched in India (Shradha & Budhedeo, 2016; Biswas, 2021).

10 Challenges to the Implementation of ICT in Education

Undoubtedly, ICT has the capacity to improve the education system and can accelerate its development, but there are many impediments to the implementation of ICT in India. In this section, authors talk about those challenges. For this purpose, authors consulted a good number of academicians, education experts, and a few government officials. On the basis of the data collected from these resource persons, a total of 11 most common challenges associated with successful implementation of ICT in the education sector in India are listed below.

1. Illiteracy is one of the major problems in the development of ICT education.
2. Lack of knowledge and training in ICT.
3. Teachers are not properly trained in ICT. ICT does not exist as a separate subject in every school. So trained teachers are rare in schools, teachers have to take a number of classes in a day, and they are bound to do multiple tasks in school. Hence, they do not have the time or interest to teach a new subject and different subject, that is, ICT.
4. Shortage of schools, shortage of classrooms, especially in rural areas.
5. Lack of interest in ICT. Sometimes it has been seen that schools and educational institutions are not interested in implementing ICT in their institutions. They fail to perceive the need of ICT in education.
6. Lack of infrastructure. Lack of computers and accessories in schools.
7. Lack of accessibility of facilities by the beneficiaries.

8. Lack of computer labs in schools.
9. Lack of teaching aids. Teaching ICT is not possible without updated equipment. Computer, software, educational database, Internet connections, etc., which are not made available in all schools.
10. Problem of insufficient funds in schools. Many schools suffer from financial problem. ICT tools like computers and accessories, software, and hardware are not affordable for all schools.
11. Language is also a barrier in the educational development. A large proportion of educational software are in English, and resource materials are in English. In developing countries like India, the English language is a barrier for a rural student, so they cannot get benefits of ICT.

11   Conclusion

E-learning has occupied a central role in the education landscape during COVID-19. These changes were about to happen, but the pandemic gave an additional impetus and a greater sense of urgency. Educational technologies were adopted by various educational institutions with an experimental mindset. This allowed organic possibilities for customizations and developing unique competitive advantages for institutions. However, certain issues should not be overlooked. Especially, digital inclusion and equity are vital for a country like India that has got millions of people lacking handheld devices or Internet for accessing e-learning (Ward et al., 2021). The urgency to adopt e-learning also meant uncritical inclusion of content and learning methodologies, some of which might not fit with Indian ideals of education. Application of ICT in education has a significantly positive impact on the learning process (Nair & George, 2016). ICT facilitates the accessibility of education by breaking geographical barrier. Educational development can reduce the gap between rural and urban areas (Djan & George, 2016). Rural schools need to develop, and it is only possible with the help of ICT. Talented students are available in large numbers in rural India, but still a large section of them do not have access to modern technologies; hence, they miss the opportunity for a bright future through ICT. Those learners mainly need opportunities, which can only be possible through the utilization of ICT in a proper way in rural schools in India. Not only in rural schools, the same scenario exists in schools of towns and cities. Many school managements are still not aware of the benefits of the use of ICT in education; as a result, they still depend on written material, textbook, and class notes.

Since education provides a platform for people in socio-political, cultural, and economical mobility, the barriers in the education system must be removed. The ICT-enabled education system can bring democratization to the field of education in developing countries. For the development of the Indian education system through smart learning, a few suggestions are proposed below:

1. Use of Internet can cover up this gap. Sitting at home, a student can get knowledge or guidance on any subject, by using the Internet, online coaching, online course, or directly from teachers through Skype.
2. Easy access to the Internet and digital technologies must be provided to teachers and students and academic staff to run the education system smoothly. Internet facility, digital infrastructure like smartboard, and projectors must be provided in classrooms, schools, colleges, and teacher education institutions. It is also necessary to make digital content available for both students and teachers.
3. Teachers should have the skill and competence to use advanced digital technologies for clear presentation of content, to provide quality teaching which leads to a higher level of learning for students.
4. Schools should have their own website.
5. Students should be familiar with the basic concept of ICT. Both the teachers and students should have basic knowledge of computers.
6. Computer, software, educational database, Internet connections, etc., are not available in most of the schools. All these should be made available, so that students can take full advantage of them.
7. Schools should give importance to class lectures through PowerPoint presentations, this will help students in memorizing and understanding the subject matter. They should conduct educational programs through video conferences.
8. In rural areas educational training programs and ICT training programs should be in local languages so that people can understand them easily.
9. ICT must be implemented in teacher education for capacity building of teachers that will help them to make new teaching strategies, and lesson plans in an innovative way and to convert an ordinary class into an interactive and interesting class. Wide use of ICT and its successful integration into teacher and student education will make the future better.

In developing countries, there are many hurdles in the betterment of the education system. Barriers like poor infrastructure in educational institutions, language problems, poor socio-economic conditions, lack of good teachers, lack of resources, and lack of job opportunities cause students to drop out. In India, ICT could be the solution to these impediments that prevail in society. A lot of the ICT models were developed pre-web 2.0. These models did not give credence to the social nature of virtual learning. Also, the possibilities of decentralized knowledge centers and credential authentication brought about by block chain-based technologies needed to be factored into any ICT model in education. Finally, our study takes into account the Indian realities. This study recommends ICT adoption in the Indian education that takes into account both the reality of India and the evolving nature of educational technologies. In India, technology-based instruction largely bypassed the legacy of the Learning Management Systems which popularized online education in the west. The findings of the study may contribute to more clarity regarding approaches toward enhancing student learning outcomes at the business unit level (school/college). To conclude, it can be inferred that ICT provides broad support to all the stakeholders and can make a roadmap to achieve the goal of developing the

Indian education system through smart learning with the help of successful application and implementation of ICT in education.

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