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Information Technology in Education: An Educational Offshoot and a Monumental Add-on in Return

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Abstract

In the present world, 'information technology has brought about a virtual revolution' would be an absolute understatement. In fact, every field or sphere of life, considered generally, has been infused with a fresh life, via the channel of information technology. Moreover, the field of education is not any exception, to the good signs of information technology. The use of Information and Communication Technology (ICT) has the potential to significantly alter how teachers and students, teach and learn. ICT aids in increasing educational possibilities, enhancing the integrity of instruction and learning, prolonging lifelong learning, and enhancing managerial effectiveness and efficiency. In many ways, it can be said that the two are inseparable or work hand-in-glove. The present study aims to understand how Information and Technology are ruling the entire education system, as learning online as per the users' flexibility is gaining popularity day by day and most importantly due to the implementation of new education system in India, many ICT based programs have been included in NEP-2020 like vocational courses, skill labs and coding programs. ICT also expands students' and teachers' educational opportunities and affordances, and this ultimately will also shape the future of the education system. This paper reviews various online learning platforms such as National Programme on Technology Enhanced Learning, which is the most subscribed educational channel, having more than 1.5 million subscribers.

Keywords: Digital era, educational apps, information and communication technology, lifelong learning, SWAYAM, MOOCS, virtual revolution.

1. Introduction to Information Technology

As already pointed out, Education has a definitive role to play in the advancement of information technology in the first place. For instance, the development of microchips,

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studying of different circuit technologies, and so on, and the ultimate design of any IT products, all of these are void entities without the aid of education. The information technology helps its innate originator i.e., education to flourish further by easing the different allied tasks in the sphere of education; not to mention, opening new subjects or points of interest in education. ICT is causing rapid social change. It has an impact on every element of life. Schools are starting to notice the effects more and more. Schools are being forced to adapt to this technological advancement as a result of ICTs' increased ability to tailor learning and instruction to individual requirements for both students and teachers. The Indian government has made several changes to the educational system over the previous few decades through several different education commissions. Since the deployment of satellites in the early 1970s, Indian authorities have made every attempt to develop ICTs as a means of boosting education. Since then, India has witnessed a lot of efforts targeted at promoting ICT and its use in education, both in the public and private sectors. Both the secondary and higher education sectors are laying the groundwork for extensive and revolutionary reforms as part of the National Education Policy 2020 [1].

1.1 Contribution of Information Technology in Education

Education in a real sense gives birth to the all-encompassing information technology which is obvious; however, the giant in its own realm, information technology also pushes the boundaries of education itself, which is witnessed in institutions big and small. The usability of information technology was apparent to all and sundry when the deadly epidemical corona virus struck the world in the fall of 2019. The institutions, world leaders, and families and friends alike had to rely on it helplessly. Since the virus was declared pandemical, the educational hubs had to rely on the likes of the zoom platform to execute different tasks, viz, lectures, meetings, etc. While the epidemic has faded off to a safe degree now, the new trend of work-at-home has taken shape. People are witnessing increasing establishments including educational ones, which are imparting or delivering services via the novel technologies of the informational technology world. For example, the students who happen to have missed some lectures, are usually compensated via online mode of teaching. These are some of the offerings of information technology on a smaller scale of things. When considered on a large or a holistic scale, then the computer-based simulations have only polished the arena of the education sector. Nowadays, simulations are very much part of every advanced research assessment both in higher and lower dimensions of education. Thus, in a nutshell, the world of education has got sleeper in its effectiveness and accessibility in

relation to the magnanimous entity of information technology, and the bridge between the two presumably will get better over time.

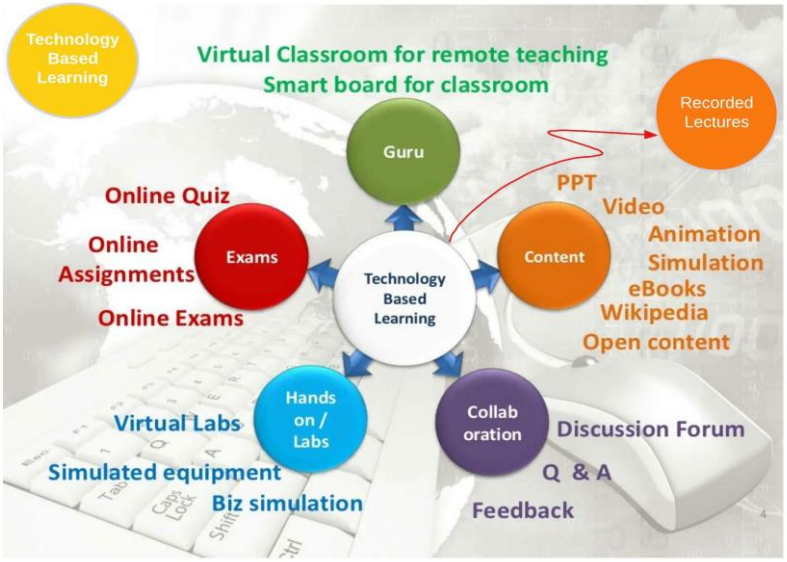

Figure 1. Virtual classroom setup

1.2 The advantages of digital teaching over traditional teaching

Every day, more and more traditional educational approaches are being replaced by digital learning. Students can master excellent self-directed learning techniques thanks to educational technologies and resources. They can recognize what they need to learn, seek and utilize online resources, apply the knowledge to the issue at hand, and sometimes even analyze the feedback. Over the past 15 or 20 years, there has been an overwhelming change in the ways that higher education is taught; while some continue to use "Talk and Chalk" technology because they still adhere to old and traditional methods of teaching. The fact that instructors no longer employ any form of contemporary technology or other contemporary system equipment in the classroom is quite astounding. The internet has a wealth of additional information on any topic, including Google, Wikipedia, and YouTube. There is no requirement for students to attend higher education institutions in order to study from these sources. Due to the abundance of new courses that online education has produced, a large number of students have enrolled in academic institutions [2]. An integrated information hub is created by connecting different information sources from around the world via digital platforms. Unlike the classroom's conventional blackboard, traditional courses frequently lack access to the latest material. Additionally, this results in differences in curriculum between nations. However, by giving all students throughout the world equal access to information, digital classrooms are able to solve this issue. Accessibility is one of the key

benefits of a digital classroom. In a traditional classroom, students must gather together and learn from a teacher. These teachings are frequently not kept in record for later use. Even if they are absent for a day, students who cannot commute to class or attend classes, risk missing out on the lectures. Digital classrooms strike the ideal blend between rigidity and adaptability. Students can learn at their own schedule because they always have access to content. In the event that the information provided is insufficient, they can also request further resources or replay the video. This keeps up with the rest of the class while confirming that every learner has understood the subject. Figure 2 shows the basic difference between traditional and digital teaching.

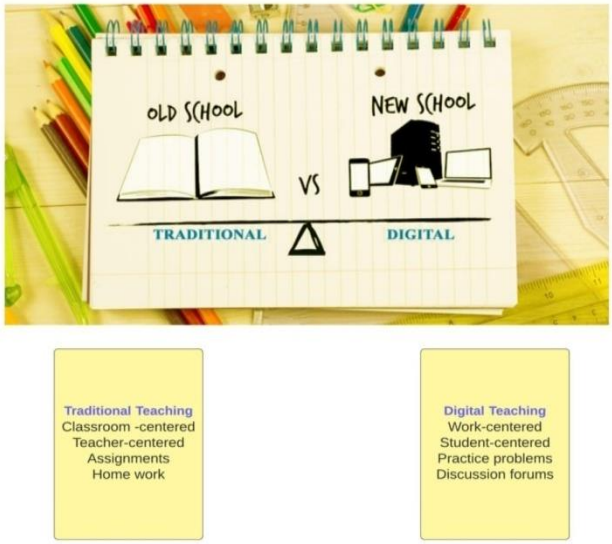

Figure 2. Traditional teaching versus digital teaching

2. Information Technology serving as Lifelong Platform via E-Learning -An Indian Context

E-learning (online learning) includes traditional and informal learning at all levels that makes use of a network infrastructure, such as the Internet, a LAN, or an extranet (WAN). E-portfolios, cyberspace, digital libraries, and web-based learning material archives are some of the components. All the aforementioned elements work together to give the user a unique identity and link all parties involved in education. Additionally, it makes cross-disciplinary research easier [3].

E-learning is a fast-expanding sector that allows users to exchange content in a variety of media, including videos, slideshows, PDFs, and webinars. There are numerous learning management systems and delivery techniques available. Many operations, including a course

with predetermined materials and examinations that are automatically graded, can be automated with the correct tool. In India, Ministry of Electronics and Information Technology has the biggest role to play in the promotion of IT. One of the focus areas for delivering education through teaching resources and communication media is e-learning. It is the education that ICT facilitate and assist. The development of technologies and systems to support e-learning across the nation is the overarching goal. A platform for improved learning, cost-effective distribution, flexibility of learning at the learner's comfort, consistent quality content delivery, re-usability of the content, etc., is provided by e-learning mode and the associated tools. With the help of e-learning, online degrees are currently a very widespread occurrence. For learning and certification, people are interested in enrolling in online courses.

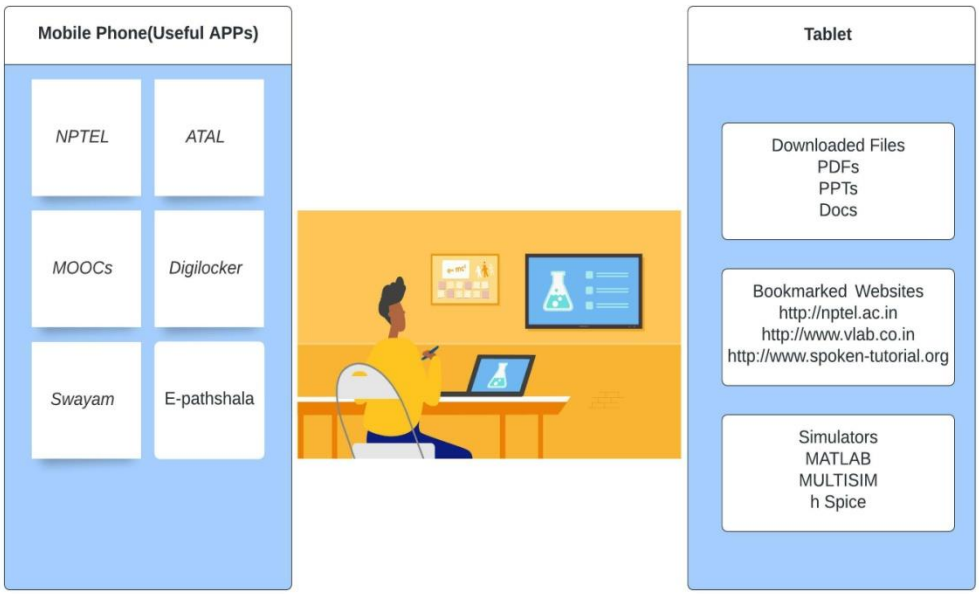

Figure 3. Depiction of learning with ICT

Top institutions use the internet and a variety of tools to provide excellent online programs. As it gains greater acceptance and recognition, this idea gains more ground. Students who work and seek flexible study options are more familiar with the online degree environment than other groups of students worldwide [4]. The first B.Sc degree in programming and data science has been offered at IIT Madras in 2022. More than 60,000 applications have already been submitted for the B.Sc qualifying procedure. More than 11,000 students from various states and union territories around the nation are now enrolled for the B.Sc program, and more than 3,000 of such pupils are enrolled at the diploma level. This distinctive program in programming and data science is being pursued by students from

a range of age groups (from 18 to 60 and above) and educational backgrounds (such as business, the arts, science, engineering, management, medicine, and law). 20% of the students are professionals in the workforce from various industries. One of the joys of the program is the diverse expertise that the students bring to the table.

3. Digital Initiative of Government of India in Higher Education

India is making steady progress toward digital education, supported by expanding digitalization adoption by universities and colleges, rising internet penetration, and rising student demand. One of the focus areas for the Digital Initiative for Higher Education was Massive Online Open Courses (MOOCs) conducted on July 9, 2017. To create an integrated platform and portal for online learning, Ministry of Human Resource Development (MHRD), Government of India, has launched a significant initiative named Study Webs of Active Learning for Young Aspiring Minds (SWAYAM). National Programme on Technology Enhanced Learning (NPTEL), a collaborative project of the IITs and IISc is supported by the Ministry of Education, Government of India. This huge website offers free online certification programs. More than 500 courses are made available free of cost to the students and 100 new courses were introduced in the year 2020.

This project was started with CSR funding from Amadeus Labs Bengaluru to give students an integrated platform to prepare for GATE. In 2013, the 4-, 8-, and 12-week online courses that typically include themes of interest to students in all years of higher education as well as foundational core courses in the sciences and humanities with exposure to pertinent tools and technology have been made available through an online portal. There is no fee associated with enrolling in these courses or learning from them. A certificate is issued by the participating institutions and industry, if appropriate, and a proctored certification exam will be offered in person for Rs. 1000 per course. In order to increase the selection of services and courses for learner skill enhancement, NPTEL has introduced the new platform NPTEL+. Currently, three different training program types are suggested:

1. NPTEL is now offering self-paced courses that allow students to move through the material and complete tasks at their own pace. After enrolling in these courses, students can watch video lectures and finish tasks at their own pace. The option for learners to write a remote proctored online exam from the convenience of their homes and receive a certificate is also available.

2. It is planned to offer short-term training programs that may combine live lectures with practical instruction or a blended learning approach (recorded videos plus live lectures). These would largely be taught by faculty from different IITs, IISc, etc. and would take place on certain dates and at set session times.
3. Courses from institutions and organizations that collaborate with NPTEL are included in these programs. The materials are geared for specialized courses in a developing technology or serving as a complement to the current NPTEL courses with specialized hands-on content to prepare the students for the workplace.

3.1 Spoken Tutorial

Spoken Tutorial is a multi-award-winning educational content portal. Here, one can independently learn about different Free and Open-Source Software. Anyone with a computer and a desire to acquire knowledge can take programs from anywhere at any time in a language of their choice. The National Mission on Education through ICT, established by the Ministry of Education, Government of India, is the funding source for the Spoken Tutorial project. IIT Bombay is focusing on the Spoken Tutorial project.

3.2 Atal

Atal Ranking of Institutions on Innovation Achievement (ARIIA) is an initiative of Ministry of India, MHRD, to compare the development of innovation and entrepreneurial measures across all of India's top universities, colleges, and other higher education institutions and evaluate the institutions on a systemic basis. Some of the major initiatives include Jal Shakti Abhiyan, One Student One Tree, AICTE-UKEIRI 2020-21, Smart India Hackathon 2018, AICTE-ECI Vishwakrama Award 2017, Startup Contest 2017, Launch of SWAYAM, AICTE-CII India Innovation Initiative (i3), Clean & Green Campus, NEAT and ATAL FDPs, etc.

3.3 Centre for Distance Engineering Education Program (CDEEP)

The course materials from IIT Bombay are now available to engineering and science students throughout the world due to CDEEP. The IIT Bombay faculty's knowledge is shared by CDEEP with students and working professionals. The same courses that are provided through distant learning are also offered to students at IIT Bombay. CDEEP is accessible online and from any location to reach as many learners as possible.

3.4 National Mission on Education through Information and Communication Technology (NMEICT)

The NMEICT was created with the goal of maximizing the value of ICT in the teaching and learning process for all students in higher education institutions, regardless of location or time. In order to increase the Gross Enrolment Ratio (GER) in Higher Education by five percent throughout the XI Five Year Plan period, this was anticipated to be a significant intervention. The Mission is a historic project of the government's MHRD, which was introduced in 2009 with the aim of smoothly delivering top-notch educational materials to all eligible and eager students in India.

Access, equity, and quality are the three guiding principles of education policy that could be well served by connecting all higher education facilities, providing students and teachers with low-cost, accessible computers, and offering top-notch online learning materials to all students in the nation. All three components are included in NMEICT. There are three main parts to the Mission:

- Creation of content,
- Supplying connectivity to institutions of higher learning, and
- The research and development of inexpensive access devices.

As part of NMEICT, connectivity is currently being provided to 419 universities, university-level institutions, and all colleges, including polytechnics. A new initiative dubbed Campus Connect also aims to make campuses Wi-Fi-enabled. It aims to close the gap between urban and rural teachers and students' abilities to effectively use computers for teaching and learning in higher education and to give those who are until now been left out of the technological age and unable to fully participate in the knowledge-based economy power.

The mission's focus areas include developing effective e-learning teaching methods, offering the ability to conduct experiments through virtual laboratories, offering online testing and certification, making teachers available online to mentor students, preparing teachers to use the new techniques effectively, utilizing Education Satellite (EduSAT) and Direct to Home (DTH) platforms, and more. The National Digital Library (NDL) has taken on the enormous task of gathering and harvesting all the digital and digitized content available throughout the nation's educational institutions, indexing them, and hosting them to make open content searchable and accessible from a simple interface.

3.5 Virtual Labs

Virtual labs also known as vlab, a magnanimous and a fairly mammoth project is an initiative constituted by the MHRD, Government of Indian union, which further runs under the auspices of NMEICT. The project is working amalgamation of twelve principal institutes, and the duties of overall rapport and coordination is looked after by the IIT Delhi. A paradigm shift in information and communication -based education, the first- of- its- kind initiative has been taken up a remote- experimentation basis. The virtual labs are designed and established virtual- model labs which consists of seven hundred well enabled experiments for a remote or otherwise on-lined operations and viewing.

3.6 Digilocker

One of the main projects included in the Digital India Program is Digital Locker. With the help of Digital Locker, organizations can share electronic documents and cut down on the use of paper. This portal enables the sharing of e-documents through authorized archives, confirming the legitimacy of the online papers. Additionally, utilizing the e-sign feature, users can submit their personal virtual documents and digitally sign them. Sharing these digitally signed documents with government entities or other organizations is possible.

3.7 OSCAR

The Open-Source Courseware Animations Repository (OSCAR) offers a collection of internet collaborative models and animations or "Learning Objects" (LOs). These educational resources cover themes in mathematics and science as well as engineering and technology at the community college level. In the project OSCAR, each LO includes six essential parts.

- The learning objectives- which spell out what students will be able to do once they have finished the objective.
- A succinct explanation of the idea being discussed.
- A learning exercise in which the user can participate by defining and altering parameters to observe the result.
- Quiz-style self-assessment that allows a user to measure his/her level of understanding following viewing the LO.
- Resources for additional reading.
- The ability to access the animation for later use [5].

3.8 Free/ libre and Open-Source Software for Education (FOSSEE)

FOSSEE project encourages the employing of Free/ Libre and Open-Source Software (FLOSS) tools in order to enhance the education benchmark. This project encourages the use of FLOSS technologies in research and academia. The FOSSEE project is a component of the National Mission on Education through ICT Ministry of education, Government of India. The projects that FOSSEE promotes are shown is table 1 below.

Table 1. FOSSEE Software

Python	esim	scilab	OpenPLC
SOUL	FOCAL	OpenModelica	DWSIM
Osdag	QGIS	SBHS	FLOSSArdunio

3.9 ePathshala

ePathshala is an educational application offered by The National Council of Educational Research and Training (NCERT). The primary goals of NCERT and the unit (National Institute of Education, Central Institute of Educational Technology) that make up the organization are to conduct, encourage, and coordinate research in fields related to school education, create and publish model school books, supplemental materials, bulletins, journal articles, and educational kits, and develop media digital content, organize teacher pre-service and in-service training, and create and share cutting-edge instructional strategies and methods.

Table 2. Features of Educational Applications

S.No.	Features	SWAYAM App	Spoken Tutorial App	ePathshala App	Digilocker App
01	Version	3.19.0	1.0	3.0.3	7.1.9
02	Released On	23/08/2016	11/12/2012	05/11/2015	23/12/2015
03	Offered By	IITM	Satpute.harish	NCERT	National eGovernance Division, Government of India
04	Utilizers	Students, Teachers, and Researchers	Students, Teachers, and Researchers	Students, Teachers, and Researchers	All Indian Citizens

05	App Language	English	English	English, Urdu, Hindi	More than 10 Languages. English is the definitive version.
06	Content Availability Form	Multiple forms such as Video, audio, image, presentations and PDF	Multiple forms such as video, audio, image, presentations, and PDF	Multiple forms such as video, audio, image, presentations, and PDF	Stores document in form of image and PDF.
07	Domain	Engineering & Technology, Health Science, Management & Commerce, Math and Science, Architecture and Planning, Law, Humanities & Arts	Teaching & learning a particular free and open software like, Linux, Scilab, Latex, C/C++ etc	NCERT Textbooks & eResource including Audio, Video, and Periodicals etc.	Stores Official documents such as Educational Certificates, PAN, Driving License & Aadhaar etc.

Some other digital education services include e-PGPathshala, DBT-Junior Fellowship, UMANG, Central Board of Secondary Education (CBSE), National Digital Library (NDL) , Impacting Research Innovation and Technology, IMPRINT, E-Shodh Sindhu (eSS), E-Kalpa, Talk to Teacher Program, Global Initiative of Academic Networks (GIAN), National Institutional Ranking Framework (NIRF), BAADAL, SAKSHAT, and Gyan Vani etc. Features of some above-mentioned applications are shown in table 2. Apart from the above motioned websites and apps, the following are some leading educational applications.

Table 3. Name of the other leading educational applications

S.No.	Name of the Application	Description
01	Khan Academy	An American non-profit educational institution called Khan Academy was founded in 2008. Its objective is to develop a set of online resources to aid in student education. The company creates videos with brief teachings in them. Additionally, it offers teachers additional practice materials and tasks on its website.
02	Unacademy	An Indian online learning platform by the name of Unacademy is based in Bangalore, Karnataka. It was launched in 2015, by Gaurav Munjal, Hemesh Singh, and Roman Saini. It gets students ready for several competitive tests like JEE, NEET, UPSC CS, GATE, UPSC NDA, NET,

		Boards etc.
03	Physics Wallah	A free educational app is the Physics Wallah Alakh Pandey app released by Alakh Pandey. Students who are preparing for the IIT JEE and NEET exams can use this app. Students can access the Physics and Chemistry video lectures via this app wherein, all learning materials are freely available.
04	Coursera	The large open online course provider Coursera was established in the United States in 2012 by computer science experts Andrew Ng and Daphne Koller from Stanford University. Coursera offers online courses, certifications, and degrees in a range of areas in collaboration with universities and other organizations. About 150 colleges were providing more than 4,000 courses through Coursera in 2021.
05	Diksha	The Nationwide Council for Educational Research and Training (NCERT), working under the direction of the Ministry of Education (MoE), Government of India, created the national platform for school education known as DIKSHA (Digital Infrastructure for Knowledge Sharing). Almost all states, union territories, and federal autonomous bodies/boards, including CBSE, have accepted DIKSHA since it was introduced in 2017 by the Honourable Vice President of India, Shri M. Venkaiah Naidu. There are 36 Indian languages currently supported by DIKSHA, which is accessible to students and instructors across the nation.
06	BYJU’s	BYJU's is an online tutoring and coaching business with headquarters in Bangalore that was founded in 2011. The learning app from BYJU was introduced in 2015. BYJU's primary goal is to offer tutoring via online video lectures to children in grades 1 through 12, as well as to those preparing for competitive exams like the IIT-JEE, NEET, CAT, UGC_NET , and GMAT.
07	Vedantu	It was founded in 2014 by IIT-alumni Vamsi Krishna, co-founder and CEO, Pulkit Jain, co-founder and head of product, Saurabh Saxena, and Anand Prakash who lead the company (Co-founder & Head of Academics). It primarily offers services to students who are enrolled in Grades 4 through 12 of the Central Board of Secondary Education (CBSE) and the Indian Certificate of Secondary Education (ICSE). Live online tutoring in STEM, Hindi, English, Sanskrit, German, French, Environmental Science, and Social Science is currently the company's

		main line of business. For its one-on-one student teacher live sessions, it employs the White Board Audio Video Environment (WAVE) technique. It offers test preparation classes for the National Talent Search Examination (NTSE), the Indian Institute of Technology Joint Entrance Examination (JEE) Foundation, the National Eligibility Comprehensive Entrance Test (NEET), and the Problem-Solving Assessment (PSA).
08	Udemy	A popular online teaching and learning platform is Udemy Inc. It was launched by Eren Bali, Gagan Biyani, and Oktay Caglar in May 2010. The platform has more than 54 million users as of July 2022, 204,000 courses, and 71,000 instructors who are offering instruction in more than 75 languages. More than 741 million students have registered for the courses.

4. Security of Education based Apps and Websites

Nevertheless, despite the advantages of e-learning platforms, these web-based programs are vulnerable to cyberattacks. As a result, web security has been researched in several research projects across the globe in various systems, such as cloud computing, e-learning platforms, and others. Security is, in general, the characteristic or state of being safe from harm. In this context, the Ministry of Industry, Trade, Investment, and the Digital Economy started the national campaign against cybercrime (2014–2017). Numerous security issues must be researched in response to the increased interest in cybercrime, and secure programming education must be improved [6]. A crucial role for computer security is played in the field of data technology.

The applications discussed in table 2 are completely secure and are safe to use. For example, considering SWAYAM platform, the website keeps track of one's visit and log data such as the IP address of one's server, the upper edge domain one uses to access the Internet (such as.gov, com, or in), the type of browser one uses, the time and date one accesses the site, the pages and documents one have accessed, and the previous URL one used to link directly to the site for analysis purposes; but the management team cannot identify the user on their browsing history. Only if the user decides to send a message, then his/her email address will be saved. And it won't be added to the mailing list and will only be used for the reason user mentioned in mail. Without user's permission, user's email address won't be disclosed or used for any other purpose. Some other applications like Digilocker system allows the user to access the site without signing in, and the management will not be able to

capture any specific information about the user. Furthermore, there is Aadhaar authentication and eKYC options for safeguarding the user formation.

5. Literature Review

Nearly every element of modern life has been touched by technology, and education is no exemption. Education has existed in various forms since the emergence of the human race. This is due to the fact that education, or the act of promoting learning, has always been important. After all, no generation can be properly prepared for the responsibilities to undertake in the world without education. Before technology, there was only oral transmission of knowledge as a form of education. The major goal of traditional education is to teach the next generation the morals, manners, and social customs that are essential to their survival.

In the modern world, paradigm shifts have shown that the Industrial/Machine age is being superseded by the Information/Technology era. Similar to how the focus of the production process has shifted from workers to customers, the workplace has gone from being physical to virtual. This means that, one should develop knowledge that is virtual and student-centered in terms of education. Virtual access is made possible through intranets and the internet. A student can obtain information without physically going to the area where it is delivered by using methods including email, web announcements, discussion forums, and video conferencing. These traits characterize a typical interactive e-learning system, which illustrates the paradigm shift [7]. This paradigm shift took place in education system when the National Policy on Education in 1986, which was revised in 1992, and placed a strong emphasis on the use of educational technology. Two significant centrally sponsored programs, Educational Technology (ET) and Computer Literacy and Studies in Schools (CLASS), were created as a result of the policy statement, laying the way for a more comprehensive centrally funded program in December 2004. Sarva Shiksha Abhiyan (SSA), the Government of India's main education program, includes the use of ICT for quality enhancement.

ICT once more plays a significant role in the educational standard that the Central Advisory Board of Education (CABE) advocated in its 2005 report on Universal Secondary Education. India, with more than 500 universities and over 30000 colleges, is the third-largest educational system in the world, after the United States and China. In order to implement ICT-enabled education in such a vast system, one needs high-quality, multimedia-rich

content in a variety of disciplines for various courses, including its multilingual conversion, capacity building of teachers and students in ICT skills, and cutting-edge infrastructure along with networking and internet connectivity via Virtual Private Network (VPN) / broadband connectivity for disseminating the content and reasonably priced access devices so that it can be used by all students. The continuing National Mission on Education through ICT (NMEICT) is a significant effort by the Indian government in this regard with the goal of using the potential of ICT to offer all students free access to high-quality, personalized, and interactive content [8].

In order to further enhance the education system in India, many digital initiatives were introduced by Government of India such as NPTEL, SWAYAM, Spoken Tutorial, ePathshala, and SAKSHAT One Stop Education etc. Current study shows that SWAYAM has student enrollments of 18813698 with successful certification of 1094577. This review has examined how Information Technology has changed education sector in India and has reached its milestone.

6. Conclusion

Since having penned about the booming evolution of information technology to this day, this research paper, however, particularly puts into context the commissioning of National Educational Policy 2020 (NEP-2020), in India , in relation to the incorporation of vocational courses and extensive employing of Information Technology. The draft of the NEP-2020 categorically directs at the initiation of different vocational courses at the elementary school level to the higher- tier institutions, and the all-encompassing Information Technology space to be employed in the institutions. No surprise then, that the online acquirement of many certificate courses has been touted as equivalent as the offline acquirement of the same. This therefore shall work to the overall enhancing of the student enrollment by the dint of Information Technology in the midst of various vocational and online courses. Information Technology is here to stay truly relevant, especially in the field of its origin i.e., the Education.

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