

# Cloud Computing: A Changing Education Imperative during COVID-19

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**Abstract**— The world was running at its full swing and a sudden pandemic knocks the door entering through the gates of China. A worldwide lockdown was declared knowing the growth rate of the pandemic, COVID-19. Struggling with it and the lockdown, Work from home (WFH) all over the world was initiated especially for service organizations. The academic institutions were temporarily shut down following government instructions. The only hope of the education community was virtual classes and since then the boom of online learning and teaching started like never before. In the present paper, an attempt has been made to highlight the impact of lockdown on the teaching – learning process. This paper explores to assess the boom of the virtual classes all over the world and its various benefits alongwith certain limitations. The major problems faced worldwide are the issues of awareness, availability of network and lack of training as well. The significant drawbacks of virtual classes faced are the attendance and lack of connectivity due to network issues especially in remote areas.

The educational institutions alongwith schools, colleges and universities are closed. Home schooling has become a new challenge and it is not only a massive shock to parents' productivity, but also to children's social life and learning. Many families around the world are facing number of challenges. The crisis crystallizes the dilemma policymakers are facing between closing schools and allowing workers to work at home to maintain the economy. The scale of teaching is untested and unprecedented and totally moving online. The evaluation and assessments of students are also moving online, with a lot of trial and error and uncertainty for everyone. Many assessments have simply been cancelled. These issues can have long-term consequences for the affected cohorts and are likely to increase inequality.

The modern age of technology is trending with digitalization and reshaping the education around the world. Advancement of new technologies and innovations are transforming education in numerous ways and creating education through computational ecosystem. "Revolutionizing Computing systems called, Cloud computing" which is supposed to be totally changed scenario of computational systems. Since it is cheap, no need to hire professional IT to maintain server, no wastage of money on acquiring server OS licensing, and user friendly. Hence, it could be sustained at any level of educational institution easily. Corona virus, now declared as pandemic, is causing widespread shutdown. It is clear that the world needs a quick & safe solution right now to combat further spread of corona virus. This is where cloud computing technology comes into play. It will be very interesting to see how cloud computing will explore and contribute its effectiveness towards education industry. The aim of this paper is to simply present the position of current

state, status and impacts of cloud computing in education system in view of COVID-19.

**Index Terms**— COVID-19, Cloud Computing, Distance Learning, Digital Curriculum E-Learning, Teaching.

## I. INTRODUCTION

Education is the most important sector of modern economies which prepares the individuals for working effectively in a society. Indirectly, all other fields are somehow dependent on it. A good education provides good professionals who contribute immensely to the society. Tremendous growth of information and communication technologies has positively affected the field of E-Learning. However, recently the education mode is shifted from the traditional classroom to E-Learning due to widespread COVID-19. The increasing demand for E-Learning during COVID-19 is considerable. E-Learning tools will help to continue Learning-Teaching according to institutional requirements. All the developed countries have reached their milestones through proper education and hard work. To improve the educational system, modern societies are using the blend of face-to-face education with E-Learning. Recently, the widespread COVID-19 epidemic has highly affected the education sector of almost all the countries. Billions of educational institutes around the world are closed due to lock-down strategy adapted for overcoming COVID-19. In such a situation, students' career is on the risk and society will face the delay in getting good professionals on time if the education process continues to be affected. In such situations, E-Learning is the best solution that provides an online interactive learning environment for the students. COVID-19 is a global issue, and we all need to play our part for the smooth running of economies. E-Learning is not the new phenomena; a lot of educational institutions in the world are using it from past two decades. However, the dominant mode of education all over the world was face-to-face interaction where the learner attends the school and appears to the classes and assessment physically. Currently, due to COVID-19, this mode of education is not possible, and paradigm is shifted to E-Learning. The whole world was not expecting this quick paradigm shift, and they were not fully prepared for it. Although there exist a lot of E-Learning platforms to assist the teachers and students in continuing their education. However, the availability of course contents was more valued while designing these systems and the security aspect was neglected. Due to which a lot of security breaches in E-Learning systems are reported daily [17].

The general education system in India is based on both

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traditional and modern classroom and requires the students to attend the school classes regularly. It is based on compulsory programs for all citizens. Children start school from the early age and study at the elementary level for four years, they continue to middle school from fifth to ninth grades that are the mandatory level for everyone. From the tenth to twelfth grades are treated as secondary education. Main educational methodologies are:

- In traditional classroom education, books, blackboards are used by the trainer as a teaching aid.
- In modern classroom education, classrooms are equipped with whiteboards, projectors, audio-visual sophisticated display equipments and digital boards.
- In online education, the information technology and communications are used to help in the development and acquisition of knowledge from the different remote locations. Internet mainly utilizes, audio/video and text communication and software to create the learning environment[6].

### II. RELATED WORKS

Many studies have ready been studied since corona virus disease (COVID-19) was reported at the initial stage and various forms of related literature demonstrates the need for readiness of countries during cases of pandemic in the direction of education. Children are found to be protected from critical and serious infections, even they might become the sources of spreading the virus, that was the prime reason to shut down the schools worldwide [2].

The article of *Rohit C Khanna1, Maria Vittoria Cicinelli and Suzanne S Gilbert* stated in the review article that restrictive measures like social distancing, lockdown, case detection, isolation, contact tracing, and quarantine of exposed the most efficient actions to overcome the disease spreading[3].

The study of *Giorgi Basilaia and David Kvavadze*, depicted the capacities of the country and its population to continue the education process at the schools in the online form of distance learning. The study depicts the different ways of available platforms and points the ones that were used by the support of the government, such as online portal, TV in School and the alternatives like Zoom, Slack and Google Meet, EduPage platform that can be used for online education and live communication and gives examples of their usage[6].

Another study of *Mnyanyi and Thamarana, S* have done on a case of English language teaching and learning using the virtual distance learning environment and came to the result that Virtual environments allow students to create a world that encompasses anything they can dream up. Interaction, simulation, and collaboration enable learning in the interactive environment [20][27].

The paper of *Brazendale, K* expressed that prolonged school closures and home confinement might have the negative effects on children's physical and mental health [7]. The article of *Brooks S.et al.* revealed that the "psychological impact of quarantine is wide-ranging, substantial and can be long-lasting" [8].

The effective article of *Sintema J* have shown although there are some examples of having a plan of using the distance/online learning during the pandemic, they are mostly

concentrated on small cases and not a global crisis as it is happening in COVID-19 pandemic of 2020. Especially the countries that are having the limited technologies have problems in schools are not ready for the complete implementation of the countrywide online education [26].

### III. CLOUD COMPUTING EVOLUTION



**Fig 1. Cloud Computing Evolution [24]**

“Cloud Computing” came in picture in early 1996, with the first known as Compaq internal document. The word “cloud” was used as a metaphor for the internet and standardized cloud -like shape was used to denote a network on telephony schematics & also used to refer platform for distributed computing & also used to refer platform for distributed computing as early as 1993. However, its background history also reflects some relationship with grid computing and other technologies such as utility computing, clustering, virtualization systems and high performance computing. Cloud computing was popularized with Amazon.com released its First Public Cloud i.e. AWS (Amazon Web Service) in 2006[22]. In 1960 the basic concept of cloud computing was published, when John McCarthy viewed that, “computation may someday be organized as a public utility”. Cloud is the best tool for higher educational institution a wide range of benefits with new capabilities to incorporate in the educational process interacting with 3G and 4G advanced Cloud, the prospectus of performance deliver web standard and application. The growth of educational systems like schools, colleges University, Training Centre and several educational places are involved and change them depends upon requirement and time need. Conventional educational systems is actually deals with class room based teaching and learning; though today apart from the several education mediums are evolved and growing rapidly. E-learning, Distance Education and Online Education is also an important role of contemporary learning. Cloud computing can help communities and nations to transform education. An entire world of knowledge can now be made available to teachers and students through cloud-based services that can be accessed anytime, anywhere, from any device [23].

#### A. Definition

A number of experts have different views to define cloud computing as per their perception; some of them are as follows:

According to *Foster, Zhou and Liu* in 2008 explained that “A

large scale distributed computing paradigm that is driven by economies of scale in which a pool of abstracted, virtualized, dynamically scalable managed computing power, storage, platform and services are delivered on demand to external customers over the internet"[11].

According to engineering definition by Aaron "Cloud computing is providing services on virtual machines allocated on top of a large physical machine pool". From business perspective it is defined as a method to address scalability and availability concerns for large scale applications [1].

According to IBM "Cloud computing, often referred to as simply "the cloud," is the delivery of on-demand computing resources-everything from applications for data centers-over the internet on a pay-for-use basis"[18].

But till this date the definition by National Institute of Standards and Technology (NIST) is the most appropriate and succinct definition covering all aspects of CC, thus it is considered as the standard definition which states "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider's interaction"[21].

### B. Cloud Service Models:

Most cloud computing services fall into three types of broad categories. The cloud models for service provide lots of utilities to students, teachers and researchers. Large numbers of educational institutions are running SaaS applications. Discussed below are the various services offered through cloud computing:

1. Software as a Services (SaaS)
2. Infrastructure as a Services (IaaS)
3. Platform as a Services (PaaS)

**SaaS in Education-** It allows educational institutions to use application through a platform cloud via the internet. The benefits of SaaS are, it eliminates the expense of software licensing, installation and support.

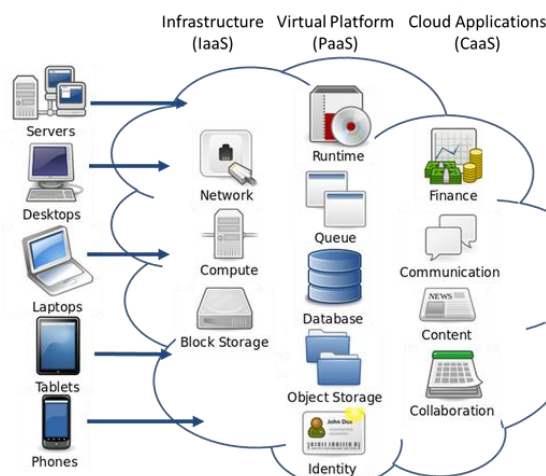


Fig.2: Cloud Service Models [13]

**IaaS in Education** - Provides the educators with the virtual infrastructure to deploy and run software, including applications and Operating System. The computer labs are the key elements in the teaching and learning of information

technology. Infrastructure needs of students, faculties and researchers are satisfied by using IaaS.

**PaaS in Education** – It supports teachers in their development of applications via programming languages, services and tools that the cloud platform providers offer. E.g. an educator can design a customized virtual lab for the students using a PaaS[4].

### C. Advantages of Cloud Computing

- ❖ **Online form of Computing:**
  - Users can access applications via a browser, while application is installed and stored on a server. Example - Google Docs.
- ❖ **Reduced Cost :**
  - It helps keep the cost down for both the users and website owners.
  - Users do not have to pay for infrastructure, installation and maintenance only user has to pay the service charges according to usage, i.e. for computing power and other networking resources.
- ❖ **More storage-**
  - It provides more storage than personal computer.
  - User do not have to worry about installation, email servers, anti-viruses, backups, web servers and both physical and logical security of data.
- ❖ **Automatically updates:**
  - Owners do not need to hire more than one server for updation of software's.
  - The server gets updated automatically and even user services.
- ❖ **Mobility:**
  - It allows users to connect anytime and from anywhere in the world as long internet connection exists.
- ❖ **Shared Resources:**
  - Any organization or institution can share their resources.
  - It saves time and money by placing their resources at one location which is easy for users to access.
- ❖ **Computing flexibility & No downloads required:**
  - It has more flexibility than network computing systems.
  - Users do not need to download anything, so its time saving and space exists on hard drive. It stores all onto the network.

### IV. EFFECTS OF COVID-19 IN EDUCATION FIELD

The novel corona virus disease (COVID-19) or also known as the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has been recognized as the cause of respiratory infection in Wuhan, Hubei Province, China, in late December 2019. As of 8 July, 2020, this epidemic had spread to worldwide with 1, 15, 91,595 confirmed cases, including 537859 deaths. Immediately, the World Health Organization declared it a Global Public Health Crisis.

Corona virus causes respiratory illness coughing, sneezing, breathlessness, and fever including pneumonia. The disease is transmitted person to person through infected droplets [4]. Govt. of India has confirmed active Cases - 264944 and Deaths- 20642 upto 8 July, 2020[9]. WHO is working round the clock to provide advice, help and prepare the countries, increase expert networks to manage and control the wide spreading of COVID-19. It has also launched free messaging services in collaboration with Whatsapp and Facebook to provide awareness to the common people regarding this rapidly growing communicable disease.

Education is another industry which highly got affected due to COVID-19. In India the education system is based on both kind of education i.e. traditional and modern classroom education and requires the students to attend the school classes every day. The situation in general education in the country has changed in the spring semester of 2020, when the first case of corona virus COVID-19 infection was detected in India. The learning process in India announced by Government of India a state of emergency with restrictions, suspended from the 21 of March-2020 by the recommendation of Ministry of Human Resource Development, Department of School Education and Literacy [5].

India also became a country among other countries worldwide that has shut down all schools. In a situation where the students are not allowed to go to school, the alternative is to move from traditional to online education. In this case the essential parts are the internet coverage, availability of computers and smart phones in the population. The number of the computers owned by families, especially in the rural areas of the country are lower than a 50%, that can have a negative influence on the whole online education, but in some cases, the modern smart phones can be used as a substitute, if the platform of education is mobile friendly or have the mobile application available. The Ministry of Education, Science, Culture and Sport of India has made the Microsoft team's platform available for all public schools in the country. The Education Management Information System has created the accounts for all teachers and students and has built-in the virtual classrooms for all classes and relevant subjects by default. Additional online instructions were published for teachers and students to use the system (MHRD 2020, Ministry of Human Resource Development, Department of School Education and Literacy) to strengthen distance learning methods [24].

Many countries have introduced worldwide so many solutions during the pandemic to carry on education. Online libraries, TV broadcasts, guidelines, resources, video lectures, online channels were introduced in almost maximum countries. To increase the coverage of the school lessons to the population, the Ministry of Education, Science, Culture and Sport of India, in cooperation with Indian Public Broadcaster's First Channel has launched the educational project titled - "Digital Classroom" (TV School). The live transmission of lessons is broadcasted through the TV channel in different subjects nationwide which is a effective platform supported by the Ministry of Human Resource Development, Department of School Education and Literacy

has hosted the thematic resources based on the national curriculum. In this hard period, the public schools got the support from large companies such as Microsoft, Google, Zoom, and Slack are offering many of the features of their products for free. Google has announced that it is offering its enterprise video conferencing features such as larger meetings up to 250 people and recording functionality for free to G Suite. The public schools have received large support from the government, but the private schools had to find their way to continue the education process in online through available solutions like- Zoom and Google Meet, Google Class Room[25].

The education management information system has reported in March-2020 that the 750 active users are involved in Microsoft Teams every day, In total Microsoft Teams has reached 138698 users, it showing a significant growth in the activity. This paper discusses, how Cloud Computing has Changed Education Imperatively During COVID-19 and has transformed the education process from traditional to online in just few months and briefs the impacts of online education. In this process many platforms like EduPage and G Suite for education are used [19].

### V. DIGITIZATION OF EDUCATION DURING COVID-19

COVID-19 is a global issue, and a lot of efforts are going on to stop the wide spread of this life-threatening virus. In this regard, some key measures that are taken by the majority of the world governments include social distancing and self-isolation. Although this social distancing and self-isolation have impacted almost every field of life, however; one of its major impacts is on Educational system that has far-reaching societal and economic consequences. According to UNESCO, about 100 countries have implemented closure of educational institutions nationwide that is impacting almost 90% of the world population. In this section we provide a broad picture of COVID-19 and its worldwide impacts in the field of education.

By closing schools, colleges and universities have not only interrupted the teaching for students around the world, many exams have been cancelled or postponed. Internal assessments are done like less important and in that many have been simply cancelled. The only point is to provide useful information about the child's progress for families and teachers. According to report of statista, millions of children were affected by school closure all over the world. The closure of educational institutes not only disrupts interactive teaching facilities for students around the world, but rather assessment also couldn't be done on proper time, and a lot of assessments have been cancelled or postponed. Internal assessment is the only source to showcase child's progress to their parents. The loss of this progress information may have long-term consequences as parents are not able to recognize potential difficulties faced by their children. A lot of specialty certificate examinations have also been cancelled [19].

According to the recent report published by UNESCO, the number of learners that are affected by school closure reached 1,543,446,152, which is almost 90% of total learners. Localized closure means closing educational institutes at the city/state/province level while Total closure means the

closure of the school at a localized level and nation-wide. These statistics include the number of learners at pre-primary, primary, secondary and tertiary education levels [14].

The education system at schools is straighter forward, then the system in the universities where the students have lots of different courses at different days and periods. When suggesting the university online transformation, the different courses have to arrange the meetings so the different students join them for different subjects. The school students have a daily fixed schedule of classes. They also mostly remain in their classrooms and different subject teachers enter a class on each hour. Many Govt. and Private schools have initiated to enter all records and information on central “electronic portal” eSchool, where the grades can be entered by teachers in the database from the school territory, but the lack of facilities and infrastructure in both Govt. and Private schools are not eligible to use this system properly. At this stage cloud-based unity of web portal and mobile application, and has been mostly effectively utilized which is suitable a general education process management at schools with the basic free functionality. The system has the functionality of timetable automation, curriculum, and attendance control, homework assigning, grading and messaging features. Parents can be part of the process where they can get the information about grades and results, attendance and communicate with teachers through the system.

*The system has a large list of interesting functions such as:* Registration and Admissions, Mobile application, Time Table, Teaching Plans & Interactive Lesson preparations, Powerful e-learning tool, Preparation of Results and Grades, Attendance Tracking, Payments Inflow and Outflow, Track students’ progress, Parent-Teacher meetings, Achievements and awards, Institutional Surveys etc. We have found an easy way to use Google’s G Suite for education to make an addition to the existing school management system for videoconferencing. It was realized that a school that used G Suite for education, could use the platform and tools available for the online teaching process as an addition. The Google has made changes to the Hangouts Meet to make it closer for remote learning and more robust for the school implementation [12]. Hangouts Meet improvements for remote learning. In particular, the important changes were-only meeting creators and calendar users can mute other participants in a meeting and Meeting participants will not be able to re-join nicknamed meetings once the final participant has left.

Each of the school classes is assigned a number, corresponding to the grade and a letter, corresponding to the group. We had to be sure that the timetable for the students will not change too much from the existing one that they had before pandemic started. To maintain the structure an email account was created for each class. A separate room was created for teachers to meet between classes and discuss the actual topics as they did in real-life before [6]. [Rat type](#) is also another useful tool for effectively use for teachers, it helps students learn to type faster and offers online typing tests to track their progress[6].

The COVID-19 pandemic has created new visionary goals through online learning plans for the students and various

crash courses for fulfilling the requirements of quarterly and monthly evaluation programs in schools and colleges. For fulfilling these tasks the torch bearers have been shown new lights of hope through technological platforms e.g. Video conferencing, cloud programs, virtual meetings apps(Zoom and WebEx), Videos and different links generated through online software. Similar programs have been planned through state governments for common teaching purpose. These online links have been shared and even the process is continuing through the efforts of state govt. agencies. Apart from this from resuming the session and moving to the next online Google forms have played a key role. Number of teams has been working and now even at the small level private as well as government institutions have been benefited by this. It has made the task like admissions and online entries, quiz programs, solutions of question papers and assignments easy. It has been made simple vide below mentioned points-

- Blackboard is like a Canvas.
- Google meeting cloud apps, Zoom Meeting, personal meetings room are in use since then in different parts of the education system.
- Video conferencing is quite beneficial for fulfilling the institutional goals and employees working from home and also for meetings through Zoom to make the things for a youth almost like professionals.
- Benefits of Google Classroom due to its familiarity to various ways [16].



Fig 3. Digitization of Education During COVID-19[10]

Like all above technological shifts and transformation efforts the biggest challenges usually involve cultural change. A few items worth pondering:

- Online learning requires discipline. Education requires discipline too, but online learning has less handholding. That reality is going to favor a certain type of student over ones that are trying to find their bearings on their own timetable.
- Learning will be digitized. Paper is somewhat comforting, as are overpriced textbooks. Both are going away (not that I'll miss the textbook price gouging). This process change will mean the faculty has to go digital and change styles.
- Existing faculty may push back and usher in a new generation of instructors.
- Analytics will become more prevalent. All you need to do is see some of the analytic capabilities in learning management systems to know that there will be a barrage of new learning metrics to ponder for students' and faculty's effectiveness[18].

The MHRD and UGC have also begun many digitalized resources for the students to access in time. Some kind of information communication technology initiatives have already been started to help in delivering study material, question papers, Video lectures, on-line lectures through Webex, Google classroom and on-line cloud computing course through its digital initiatives.

Some important initiatives of Information communication technology are taken by UGC and MHRD[15]:

- a. National Digital Library
- b. SWAYAMPRAKASHA
- c. For UG subjects e- content courseware
- d. CEC – UGC (you tube channel)
- e. UG / PG MOOCs
- f. Vidwan
- g. SWAYAM on line
- h. Shodhganga
- i. E - Shodh Sindhu
- j. E\_PG Pathshala

### VI. CONCLUSION

The pervasive COVID-19 epidemic has affected the educational system worldwide. Currently, billions of students are out of school due to this current health threat. According to UNESCO, over 100 countries of the world have announced school closure. In such a situation, the educational system is shifted to the E-Learning platform in which interactive learning is provided to students using the internet. However, there are a lot of challenges associated with it, such as the facility of internet- connected devices, especially in rural areas, the problem of bandwidth, loss of connection, etc. However, two key challenges need to be addressed to supplement the current education system. Firstly, the learning providers are not aware of the existing solutions; therefore, they are not able to choose a suitable solution according to their needs. Secondly; the E-Learning system involves personal information of the students that need to be secured from unauthorized access. In this paper, existing distance learning solutions has been briefed that might be used in the current situation. Next, we have provided a comparison of commonly used e-learning solutions based on key features that are required in the educational system.

This article also points the challenges faced by the learners and teachers and would be quite motivational for the torch bearers of the future education system. Since it explains the current situation of a country that has used the available free tools to transit the traditional school lessons to the online education during the pandemic it has a great significance for the contemporary challenges. Online learning needs to re-arrange the exams and home assignments to the open book principle that is not developed and popular for now. Preparing new kinds of such assignments in all subjects will need additional work. The problem of grading is quite real when the students stay outside of the school and new technologies has to be considered for anti-plagiarism and avoiding cheating.

Currently there was no time to get into details of quality assurance of the online teaching method as the main goal was to save the education process and continue it in any possible

format. The teaching methodologies have to be studied and improved, including the available tools and platforms. We suggest that the Google meet system to be integrated to the Google classroom platform and another solution can be that a separate platform needs to be created for education purposes that might include the laboratory practice simulators for schools in various courses. When changing to online education, the country needs to estimate how successful the process for the whole country or the world was.

Based on online teaching process at private and government schools in India, we can conclude that transition from the traditional to the online education systems at the school may be successful. The system and the skills that were gained by the teachers, students and school administration can be used in the post-pandemic period, in case of missing lessons or other similar special cases like the current one. The teachers have re-realized the distance learning in a new way; have adapted the assignments to the new format of the lessons that will be positively reflected on their qualification. The online education format can be useful in the post-pandemic period. Additional hours will be used for the individually checking the assignments and returning the feedbacks that is one of the ways to increase effectiveness in the group teaching. Students will work more independently which is the advantage of getting new skills.

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