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Comprehensive Study of Cloud Based Digitization in Education: Issues and Challenges

Vandita Sharma
Research Scholar
Baba Mast Nath University, Asthal Bhoar , Rohtak
Sharma21vandita@gmail.com

***Abstract*—**Higher education sector has been transformed over the last decade. Various emerging technologies e.g., mobile devices (phones, tablets, laptops), advanced analytic,cloud-based IT, etc. changing business operation models in all sectors e.g.,School, Colleges, Universities,Corporate learning.Before the outbreak of Covid-19 changes were at a slow pace and limited to comparatively small set of educational entities. But After Covid-19 outbreak, all universities, colleges, school, Corporate Learning, Lifelong Education moved from traditional classroom learning to online learning and teaching.Due to pandemic and lockdown educational entities leveraging benefits of existing platforms like Google Classroom, Microsoft Classroom, Zoom, etc.

Cloud computing technology allows it user, easy access and use of required services and information stored at remote location pay-per-use, via internet. It is a pool of shared resources e.g., storage, network infrastructure, application and services over distributed environment. Today many organizations based on education, healthcare and banking domain are moving towards cloud to provide various services to their clients on the pay-per -use basis.Cloud computing services are divided into three parts: infrastructure, software, and platform as a service. Cloud computing provides many advantages to users e.g., cost benefits, low maintenance, security benefits, flexibility. Low cost and maintenance features of Cloud computing make it one of the most worthwhile, practical option for Education Domain. Some major cloud service providers are Google, Amazon, Salesforce, Microsoft etc.

In this research paper we are presenting a comprehensive study of technology used at each level of education e.g., school, Colleges, Universities and Corporate Learning, challenges faced at each levels and possible resolutions.

Keywords—Software, cloud computing, network infrastructure and advance analytic.

I. Introduction

Education transforms the purpose of ‘continue the individual’s physical and personal maturity and social, economic and cultural growth and development throughout life’ into ‘educational infrastructure to foster democratic citizens who lead the future society [1]

Education is the area where impact of advancement of Industrial revolution is fundamental & drastic, Traditional ways of teaching in school/Institutions where teaching is primarily driver by Teachers. With the changes due to industrial revolution and covid situation we can’t rely on traditional way of classroom teaching. Fostering capable individuals who can utilize and accept the diverse knowledge we need to adopt Digital learning e.g., e-learning, digital classrooms. It enables more flexibility for learners in terms of at any time and at any place, what they want to learn. These features of e-learning make it popular among the youth and make them digitally literate.

The term Fourth Industrial Revolution was first mentioned by Klaus Schwab at the Davos Forum in January 2016, and is based on the digital revolution, ubiquitous mobile network, artificial intelligence, and machine learning cloud computing.

Subsequent Industrial Revolutions and Pandemic bring changes in Technologies, Innovations, education delivery system which has not been experienced throughout society ever before e.g., mass

unemployment, industrial structure and workforce, educational institutes. This new era of Revolution brings in new challenges like new talents and educational Paradigm, adopting to technologies changes. Change in technology e.g., cloud computing, mobile devices, high speed internet etc. can enable us to resolve modern world requirements of education. Technology generates a demand for knowledge and, expansion of learning and teaching, enhances knowledge and skills.

Jones Kavalier and Flannigan (2006) defined digital literacy as "skills for reading and interpreting the media in order to reproduce verbal and visual information and implementation and evaluation of new information received from the digital environment" [2]. Elvin Toffler said the illiterate of the twenty-first century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn [3].

In the twenty-first century, the global e-learning industry is increasing every year by nearly 19% and the growth is estimated to reach $243 billion Asia play an important role in the usage of the e-learning process in the industry. The prediction in 2015 was that the e-learning industry globally would earn more than $243 billion a year, and investors are ready to invest in this industry, as with augmented reality and virtual reality technologies. Because of the predicted investment by 2026, the global e-learning industry will earn nearly $336.98 billion based on increased demand [4].

Cloud computing comprises of three broad entities e.g., Owner, Cloud Service Provider, User. Owner has some services and data which can be stored on cloud, based on access criteria defined user can access it. All the activities related to storage space, Maintenance, scalability, security etc. will be provided by cloud service provider. Owner can periodically update services and data.

End user consumes Data and services uploaded by Owner hosted at Cloud service provider. To access services user must have an account with cloud service provider & web browser and internet connection. Now user can access required data and based on agreed Service level agreement. Under that agreement all the terms and conditions of services and tariffs are decided. Now user must pay based on pre agreed amount for used data and services.

Cloud service provider is an Intermediary between the user and owner. It is responsible for authorization, Disk & Data storage, processing capabilities, access control and security. Service provider can follow any of these delivery models e.g. IasS, PaaS, SaaS. Cloud provider which provider hardware & computation capabilities e.g., CPU processing, Disk Storage, Networking etc. some of the prominent players in this segment are Google and Amazon EC2. Cloud service provider who provider application and system software e.g., Operating system, Data Base. Examples of such PaaS providers are Microsoft Azure, Force.com etc. Cloud providers are those who provide application or software as a service. To access these sorts of services user need not to install any software on its local machine. Example- Gmail, outlook and 360 degree.

II. Literature Survey

Rastogi [5] evaluated the views of faculty members in educational institutions and found that education is worthless without ICT knowledge in this technological era. Nadkarni and Prugl [6] described what kinds of opportunities exist in the cloud computing world and what kinds of steps can be initiated to exploit that opportunity. Komala [7] highlighted the role of ICT in higher education and described what kinds of challenges have to be faced by the higher authority of institutions during the implementation and installation of technological equipment and cloud computing.

Another dramatic change in the education system has come about due to the corona virus pandemic, or COVID-19. The pandemic has created various changes in the teaching– learning process in the higher education system and has also impacted the way faculties and students interact with each other. So, due to this pandemic, universities and colleges were constrained to conduct the class exclusively online [8]. In this pandemic situation, many governments in various countries have taken numerous steps to avoid the spread of the deadly corona virus and also to ensure the flow of the educational institutions [9].

The education system in the modern era is now powered by digitization. Today education is supported and powered by e-learning (the convergence of the internet and learning) [10]. Digitization in education is the combined application of technology, knowledge, human skills, and instructions to make it more reachable, accessible, effective, and productive for all stakeholders involved in the process [11]. Digitization in higher education was emerging slowly as an alternative and as a support element to traditional classroom teaching. Digitization of education was happening in universities, colleges, and schools at the same time but generally at a slow pace.

III. Digitization and issues faced by various stakeholders

A. By Institutions

To build the robust and fully functional Digital infrastructure in the education system, institutions have to fulfill a large variety of requirements,

- Development of sustainable as well as sufficient funding model
- Creation of efficient staffing model
- Proper contribution of institutional leadership
- Enthusiastic and operational support from faculty members.
- Provide proper training to operators
- Engage the whole institution community
- Align with the strategies of the institution

Based on these aspects, educational institutions have to make various adjustments to provide the cloud computing environment to students and meet high financial outlay [18].

B. By Teachers

Digitization in education has brought many benefits to organizations and governments involved in education. However, various types of challenges have also been encountered [19]. Some of the difficulties faced by faculty members in teaching and delivering training in higher education are listed below:

1. ***Hurried Implementation Causes Stumbling Blocks and Limitations***

Situation caused by COVID-19 pushed educational institutions to move from traditional classroom teaching to full-fledged digital platforms. This hurried implementation has brought in more challenges e.g., Compatibility issues, inbuilt bugs in apps/platforms due to lack of Development and testing time, minimum training to faculty, handling eBooks, new software platforms. Though cloud platforms reduced some of the problems, by removing the need of installing and software updates. But it is not sufficient for its smooth functioning. But Limited Awareness levels among teachers regarding the Cloud platforms, how they operate, hardware e.g., laptops, mobiles, software e.g., Microsoft teams, Zoom, and skills necessary for delivery of lectures in online mode limited its overall benefits.

2. ***Poor Internet Infrastructure, Especially in Rural Areas, Causes Connectivity Problems***

Internet works as a backbone for digital education. Internet has spread quickly across but in many areas, it has not reached, or it has marked its presence, but bandwidth is very poor especially in rural area. Rural area's still running on older generations of telecom infrastructure e.g., 2G or 3G which is less reliable and robust. This has limited the scope of video streaming & sharing of data & information among students. 4G Internet services has been able to eliminate the bandwidth issues up to a certain extent but that is not enough to deliver 4-5 lectures daily. Power failure and network issues not only restrict lecture delivery it also restricts them in taking/recording attendee.

3. ***Lack of Face-to-Face Interaction***

Limited bandwidth of internet in most areas, pushed online classes in audio mode, or utilizing a one-sided video mode. This has led to lack of face-to-face interaction, which is limiting the growth

opportunities of students as well as restricting the efforts of faculty members in imparting education. Without face-to fact interaction becomes very difficult for faculty to judge seriousness of students in class. At the same time, it is demotivating factor for faculty members and eliminates corrective measures to involve the students in class which was very easy in physical mode.

4. ***Feedback System Is not Adequate***

Since digitization in education is new and continuously evolving, a typical way of collecting feedback is not matured. Sharing and feedback are possible using cloud platforms but feedback norms in universities and colleges differ and, in many cases, these are not clear to faculty members and students. Educational institutions should define a standard way of providing feedback, its parameters and should communicate this with their students and faculty members.

5. ***Creativity Is not at its Fullest***

As digitization in higher education is evolving, limiting both students and faculty members to exploit it to its full potential. Faculty members are generally not fully aware of the provisions in the software through which they are delivering online education. Some of the teachers/trainers who are aware of these provisions lack the hardware and other skills needed to present through the digital medium. The above reasons restrict faculty members in using their creativity to the fullest. Creativity is also lacking and seems to be underutilized when group activities are organized and presented by students.

6. ***Facing the Audience Is Lacking***

Educational curricula which involve the development of personality traits, presentation skills, and other skills to handle and face the audience in a physical mode could not be trained properly through the digital mode. It is a challenge for teachers and instructors to train students with the right body language skills through the digital medium while interacting with customers, public, and their colleagues. Students enrolled in MBA, BBA, Mass Communication, Hotel Management, and other such programmers cannot be trained to face the audience and handle the sales and other public dealing activities through these digital platforms.

7. ***Unfair Means during Tests and Exams***

Unfair means are used during online tests and exams, which could not be properly monitored by teachers with the present limitations of internet technology plus limited knowledge and training on digital platforms.

8. ***Monitoring and Evaluation Is Tough and Challenging***

Monitoring whether every student is learning and is involved in the class is a serious challenge. The virtual presence in the class needs to be supported by the right set of monitoring tools with faculty members. Responses by students in the online class are very limited. A lack of standard evaluation procedure, proper guidelines, procedures, and rules has still to be finalized and formalized. This loophole needs to be eliminated which is also an issue faced by teachers in applying the right grades to the students.

9. ***One-to-One Student Handling***

Is Time Consuming and Difficult The digital medium boasts of one-to-one student handling, which is possible but very challenging and time consuming. Expectations of the institute and students are high on this parameter but with the limited facilities available it is very tough for teachers.

10. ***Teachers Involved in Non-Teaching Activities***

The set-up of the digital mode of education involves many activities such as monitoring, attendance keeping, preparing assignments, uploading assignments and tests, downloading assignments and tests, data entry after evaluations and preparing educational videos. The effort and time given by teachers is increasing in non-teaching activities, which is less productive.

11. ***Increased Screen Time Has Led to Medical Issues***

Since people in general are not used to this digital medium the large increase in screen time on electronic devices has led to medical issues for the eyes, neck, spine, and other body parts for both students and faculty members.

12. ***Students in Government Schools and Colleges Are Poor and Cannot Afford the Digital Medium***

Some basic infrastructure e.g., smart phones, televisions, personal computers, and laptops needs to be developed to deliver the contents. It has been a challenge for faculty members and the government to impart and continue education with these students who belong to the lower sections of society.

13. ***Cannot Do Courses that Require Labs/Workshops***

Courses which require lab work, workshops can be supplemented through the digital mode but cannot be completed fully – such as Hotel Management, Science, and Business Management, Applied sciences. Also, in courses like MBA, students miss the chance of professional networking or overseas experience on the digital platform.

14. ***Ethical Values Are under Threat***

The first issue is when faculty members are taking classes and students join them but are frequently only digitally connected with no actual involvement in the classes. The second issue is that when exams are taken by students, unfair means are used by many of them. This practice applies more to college students and less to school students. This is also hampering the creativity and development of students as they are more involved with 'copy and paste' activities rather than writing the answers in their own words. When teachers point this out, students do not accept it, which raises questions and concerns, and threatens ethical values

15. ***Security of Data and Resources***

The data and resources of faculty, researchers, students, and the academic institutions shared on the cloud may be under threat. If powerful devices and instruments are installed, this data could be protected through verification, information classification, and trustworthiness on the cloud computing platform; otherwise, it may become a big issue for stakeholders.

C. BY STUDENTS

Non-Engineering Students face many challenges while accessing cloud platform. Some of the issues classified as Compatible hardware not available, lack of stable internet availability, online learning may not be preferred by all students. Staying with gadgets for a prolong period of time can cause stress, depression and anxieties.

1. Adoption of Technology

Navigating cloud platforms and applications is all together a different experience. It becomes challenging for students to learn minute details about the technology for their study purpose.

2. Lack of Motivation

Non-Engineering Students feel a lack of motivation towards digitalize learning. Digitalize learning lacks in motivational feedback & interactions, encouragement which they can easily relate in classroom learning. Physical appearance plays a very significant role in the classroom learning. Teachers resolve students' queries and make efforts to help students learn concepts quickly. This is the main reason students feel disappointed and do not like to learn just from the technological world.

3. Maintenance of Self-Discipline

Cloud computing study demands self-discipline on students' behalf. However, in digital environment it is very difficult for student to be self-discipline because there are so many things student can engage himself apart from learning.it becomes complicated to maintain classroom discipline in the absence of a teacher.

4. Lack of Accessibility

There are certain mandatory requirements to access cloud platforms which is not available to all the students e.g., hardware and software and network. Some students who belong to rural areas do not get

a good internet connection and due to this lack of connectivity, they face many hurdles during study time. Attending online classes demands high bandwidth, but often becomes impossible for rural area students.

Below table show a comprehensive classification of issues in three sets. [18]
F1- which consists of efficiency of online classes, better connectivity, better interaction with faculty, efficiency in conducting theory and practical subject classes and better options for the long term. Overall, it can be interpreted as a factor defining "efficiency and interaction". **F2-** emphasizes work life balance, time management, isolation and boredom while studying, health effects, and online learner experience. This factor may be categorized as "work life balance".
F3- consists of variables like emotional and physical support from colleagues, family and friends. A possible name of F3 can be "family support".

Table Issues Faced By Students

F1: Efficiency and Interaction	**F2: Work life Balance**	**F3: Family Support**
Effective online classes	Classroom teaching is more desirable	Adequate professional support from family, friends, and colleagues
Better for theoretical subjects	Students lacks one to one interaction with Faculty	Adequate emotional support from family, friends and colleagues
Better for practical subjects	Effect on work life balance	
Proper faculty interaction	Difficulty in managing time	
Software used is effective	Effect on physical health	
Parents have better access to information about their child	Lack of support resources (mobile phones, laptops)	
Students are confident that no compromise occurs in online learning	Learners lack online learning experience	
Enjoyed remote learning	Lack of technical know-how and poor infrastructure (i.e. internet connectivity)	
Students have good skills to learn through online learning	Feel bored and lonely in online learning	

5. SECURITY ISSUES FACED BY STUDENTS, TEACHERS,INSTITUTIONS

Below table list of Security issues [21] in cloud computing and their impact on each entity of Digital education/learning. Impact of issue can be Low, Moderate, High on students' teachers and Institutions. Significance of Impacts is depicted as High (H), Moderate (M), Low (L). High means more serious security impact, whereas low means less serious, Moderate means in between.

Conclusion: -
As the time demands, education sector has to incorporate the technology as route of delivering the knowledge to students. There is a need to find the way out to resolve the issues faced by various stakeholders for the successful adoption of cloud based digitization in education.

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