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AN ANALYTICAL ELUCIDATION OF CLOUD COMPUTING AND BIG DATA IN EDUCATION SYSTEM: POTENTIALS AND CHALLENGES FOR INDIA

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ABSTRACT

Introduction: In all facets of life, big data and cloud computing are developing technologies. They are utilized by people on a daily basis in one form or another. This phenomena is present in the educational sector. The way we educate is changing right now, and kids are relying more and more on technology, therefore we need to consider how to incorporate the newest technologies into our teaching and learning strategies. Educational institutions can better focus on providing the necessary tools to students, teachers, faculty, and staff by sharing information technology-related services via the cloud. India is a nation in development. India faces a significant hurdle in implementing this technology in the field of education. This essay examines the benefits and difficulties of using big data and the cloud in education in India.

Objectives/methods: Big Data's effects on education at all levels in Indian schools and colleges have been covered in this study. In the framework of the Human Resources Development (HRD) Ministry's New Education Policy (NEP), which is now being assessed by academics and policymakers across the country, a system architecture for Big Data education is also provided.

Findings/application: Along with other educational innovations, big data will have a significant impact on education in the next years. In light of educational technology, this study emphasises the significance of Big Data for Smart Cities and metropolitan areas. The results of this study will establish a new paradigm and be helpful in planning for the adoption of new services in learning and teaching through cloud computing technology in future educational channels.

Keywords: Big Data, Cloud Computing, Educational Impact, NEP 2020.

1. INTRODUCTION

Big Data is a necessary educational technology because of the tremendous amount of data being produced in all spheres of life, including education. Big Data and education could work well together since they will give students new learning chances. In this essay, we focused on education based on big data and examined its benefits and drawbacks. The current generation of a vast volume of data requires its management for educational purposes. The Big Data market is both regional and international. Huge amounts of data are used by international organisations including the United Nations, the World Bank, and the European Commission. Data usage has been growing tremendously in recent years, even in India. In fact, a study on

the effects of computer-based education in India was conducted back in 1979.[1] The All India Council for Technical Education (AICTE), a department of the Indian government, has established rules for engineering education.[2–5] Data experts predict that in ten years, the amount of data used will grow dramatically.[6] As a result, both small and large organisations must establish some sort of data bank.

In the contemporary environment, cloud computing has had a stronger impact on education, particularly in rural areas of all Indian states. In terms of education, the rural sector provides services for 85% of India's educational system. In comparison to their urban counterparts, rural educational institutions offer high-quality instruction along with the required infrastructure and a wealth of resources that are frequently neglected. Due to limitations like expense, distance, and expertise unwilling to travel to the rural, it is not possible to provide rural students with education of the same calibre as urban students. So, a solution that uses cutting-edge techniques in the sphere of education to address the aforementioned issue becomes essential. Our study focuses on offering assistance for enhancing the educational system in rural areas, despite their remote locations and geographic separation. Rural educational institutions have access to the most recent cloud computing technology at a discounted price. The advancement of cloud computing ideas like virtualization and SaaS demonstrates how sharing educational resources at a reasonable cost is made possible.[7]

The new educational environments would have a positive impact on educational institutions like schools, colleges, and universities as well as administrators, teachers, and students. Using cloud technology will either solve or lessen issues with infrastructure, software, hardware, and device maintenance availability, electricity costs, and other small issues. On the other hand, more students are enrolling voluntarily in schools because parents and students are encouraged by the rise in the availability of the resources required to improve education for a large number of children. Cloud computing in education can result in intelligent hands-on teaching and learning, improving student preparation. By renting out the necessary facilities as needed, the educational system is anticipated to enable teachers to more effectively illustrate the complexity of the subjects to the students. The study investigates how effectively students are taught and learned at educational institutions.[8]

Many Smart Cities are being considered for establishment all around India. This will guarantee access to cutting-edge road and fibre optic infrastructure. Big Data can therefore be utilised efficiently in these new metropolitan hubs. Many individuals have the false impression that smart cities will have all of the features of a highly civilised civilization that they have listed as desirable. Contrarily, the projected cities will have adequate transportation and telecommunications infrastructure in addition to the Swatch Bharat-required utilities. For any Smart City, adding too many complex facilities would be expensive and might not be implemented right away. Priority will be given to matters like trash removal, pollution control, building bridges and other routes to maintain open traffic flow, providing enough parking spaces, etc. Since any modern amenities offered are data-based and the success depends on the appropriate usage of the same, Internet of Things (IoT) and Big Data will have the largest impact on Smart Cities. Kochi, Visakapatnam, Bhopal, Pune, Jaipur, Indore, Udaipur, Chennai, Bhopal, Kakinada, Ludhiana, Jabalpur, Surat, Coimbatore, etc. are a few of the suggested Smart Cities.[9] As long as the States continue to show interest and take action, the list will keep growing. These cities' development will also be watched. The "Learn in India" plan of the

Indian government will be promoted through high-tech amenities in educational institutions in smart cities.[10]

This study generates a synthesis of data that directs classroom instruction and learning strategies in the growth and upkeep of students' studies of cutting-edge cloud technology and its characteristics. The subsequent analysis and interpretation give a summary of the key ideas that emerged in relation to effective teachers and students' behaviours during learning and teaching, as well as particular factors to take into account for the learning environment of the students. The analysis and application of cloud computing technology-based services at public and private colleges in rural and urban areas of the Jaipur District, Rajasthan, is the exclusive subject of the study. The main goal of the study is to learn more about how big data and cloud computing services are used in the learning and teaching processes at college technical education systems. [11]

2. RESEARCH METHODOLOGY

The New Education Policy of the HRD Ministry, which is now being researched across the entire country, is the main source of information used in this analysis. The benefits and drawbacks of the NEP have been discussed with students, instructors, and administrators from several Jaipur-area schools and colleges as well as a few educational technology developers. The study benefited greatly from the secondary data drawn from the documents and reports of the UGC, AICTE, ISRO, and other organisations as well as the Ed Tech sector.[12] Big Data will be used in conjunction with other educational technologies, such as Artificial Intelligence (AI), Virtual Reality (VR), etc., for the best achievement of NEP objectives, particularly in metropolitan centres and Smart Cities, according to the study's underlying hypothesis.[13]

This research study's goal is to compare and contrast the current state of traditional education with new education delivered using cloud computing in colleges in Jaipur, Rajasthan. To investigate the potential and constraints that cloud computing presents for educational institutions, and to put valuable recommendations into practise, even up to some measures to control difficulties that may result from implementing cloud computing in school education. This study analysed current issues in school education using both a qualitative and quantitative approach.[14]

Objectives are carried by this study are given below:
- To examine college students' and professors' activities and performance in relation to big data and cloud computing.
- To highlight impacts and role of cloud computing in education system of India.
- To measure the level of education with or without adopting cloud technology.
- To analyze the effectiveness of big data and cloud computing regarding technology.
- To highlight the benefits and difficulties of big data and cloud computing in India's educational system

3. RESULTS
3.1 Cloud Computing

The term "cloud computing" is currently all the rage in the ICT sector. It denotes the internet-based delivery of computing resources. In a nutshell, cloud computing is nothing more

than a group of highly scalable computers cooperating remotely to provide service to a customer over the internet. Another way to think about it is as performing computer tasks using hardware resources from another location. Compaq coined the phrase "cloud computing" for the first time in 1996, and Amazon.com popularised it with the launch of Elastic Compute Cloud.[15]

Instead of having to operate their regular computer software, cloud customers can take advantage of other companies providing services related to their software, data, and other computing needs.[16]

The next step in the evolution of the internet, cloud computing enables the delivery of everything as a service to you wherever and whenever you need it, including computer power, computing infrastructure, applications, and business activities. The use of a service provider is required for cloud computing. The providers offer various services.

SaaS: A completely functional and finished software product is given to users through the web on a subscription basis in the software certification and delivery model known as "Software as a Service." Email, CRM, communication, virtual desktops, games, and other applications use SaaS.

PaaS: In the Platform as a Service model, cloud providers offer the computer platform, often the operating system, database, and web servers, as well as an IDE (integrated development environment). Without the expense and difficulty of purchase, users may quickly design and execute their desired applications from the cloud platform. Web servers, databases, development tools, etc. are all used with PaaS.

IaaS: Core IT services like virtual machines, servers, storage, load balancers, networks, security, computation, middleware devices, block and file or object storage, etc. are provided via the infrastructure as a service model. On Figure 1, these service models are shown.

Figure 1: Cloud Computing Service Models Arranged as Layers in a Stack
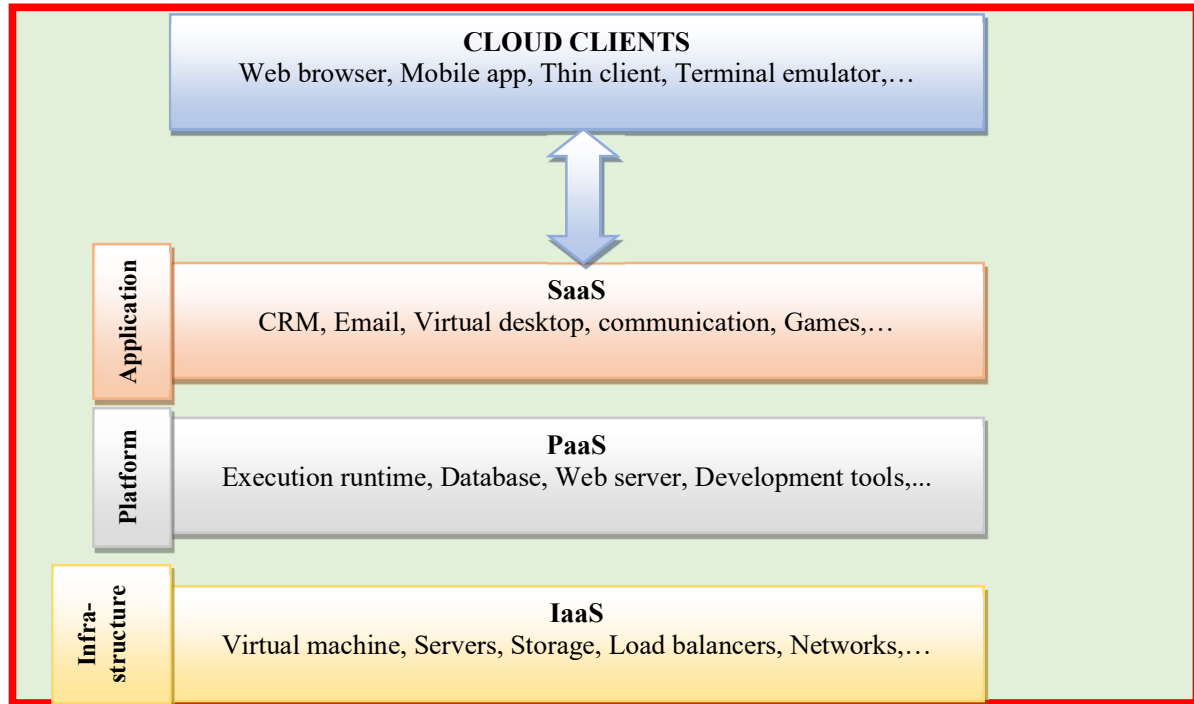
The NIST defines Cloud computing Deployment models are of four types.

Private Cloud: A single company with numerous clients prepares the private cloud infrastructure for individual use.

Public Cloud: The infrastructure of the public cloud is ready for general public use. It may be run, owned, and controlled by a combination of academic, commercial, and governmental organisations.[17]

Community Cloud: Community cloud infrastructure is set up specifically for usage by a group of clients from businesses with similar concerns.

Hybrid Cloud: Hybrid cloud infrastructures include of a number of distinct, stand-out cloud infrastructures that are connected by structured technology to enable data and application portability. Figure 2 illustrates a development model based on data from Wikipedia.[18]

Figure 2: Cloud Computing Types
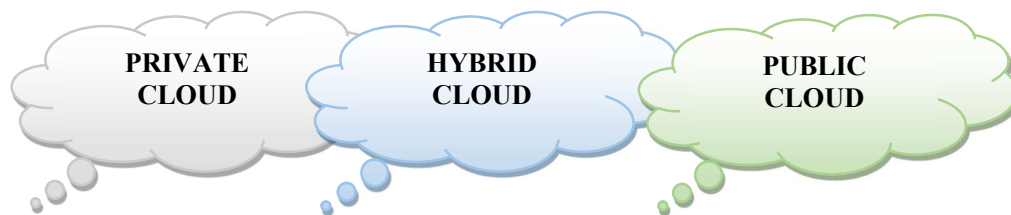
Some characteristics of cloud computing according to NIST,

In the modern context, there is no connection between the phrases information technology and educational system. In the education system at the school level, IT plays a very limited role. The majority of schoolwork is completed through handwriting clerical tasks.[19] There is no system in place for the government to monitor a student at a specific day or time,

as evidenced by the fact that teachers keep attendance registers, most schools record fees on fees registers, and many other tasks are primarily completed through paper work. Also, the teachers we trust to provide the best education for our children are not professionals; rather, they were chosen for the faculty because they are willing to work for a low wage. Also, there is no structure for daily monitoring of student attendance (in both private and government schools) and instructor attendance, and the parents are unable to see the regular or monthly growth of their wards (in government schools).[20]

3.2 Implementation of Cloud Computing Technology

Cloud computing has the potential to offer answers for all of the aforementioned problems. Once any computer system that is connected to the internet is operational, it will drive the student, instructor, or, to put it another way, the entire institute, to the cloud. To access the first and finest feature, which is the ability to track teacher and student attendance in the cloud, both students and teachers must log in using separate ids.[21] The learner has access to both live and recorded lectures. The main feature of this facility is that two students, one from any school and the other from any prestigious institution, can both take the same tutorial from a highly qualified faculty at the same time. Finally, the entire examination procedure has been altered. Exams are now administered via the cloud, and the results of every exam—even class tests—are immediately forwarded to the relevant authority. With the help of this innovative method, parents can keep an eye on their child's attendance and academic progress. With the aid of this new approach, children may halt the trend of enrolling in expensive coaching programmes and squandering their parents' hard-earned money by properly preparing for future competitive tests like the NTSE, IIT JEE, AIEEE, PET, and PMT.[22]

Figure 3: Various Services Attached to Education Cloud
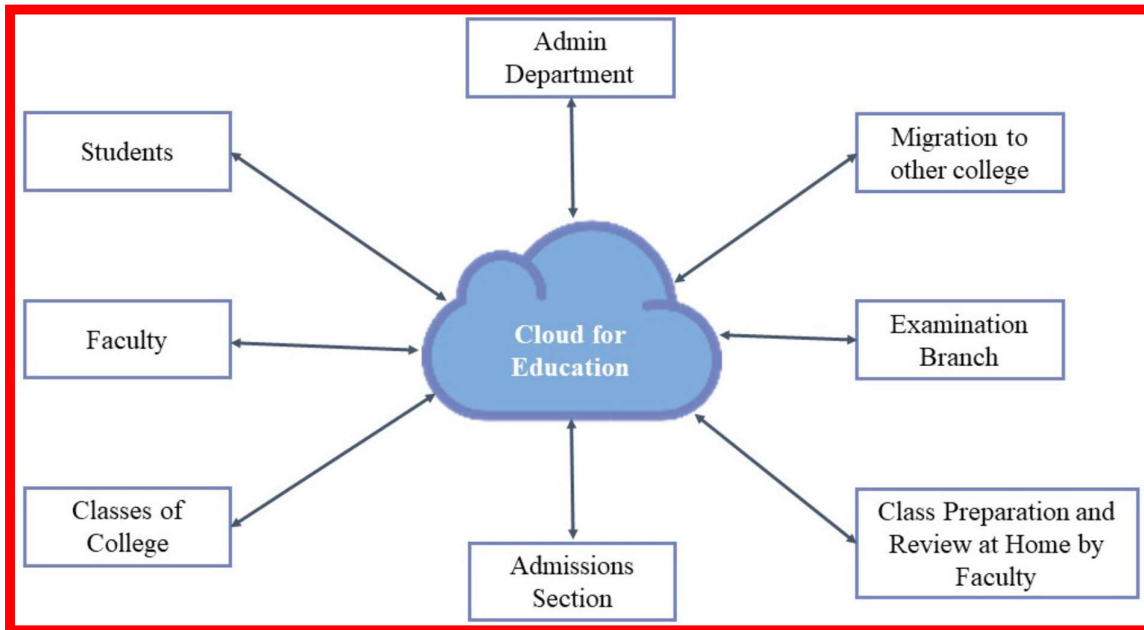
3.3 Big Data in Education

Big Data is used in today's environment at all levels of education, from elementary schools to colleges and universities.[23] The teachers will be better able to assess the kids' behaviour patterns. Institutions are better equipped to use Big Data tools to examine the data and make informed judgements.[24] Teachers will observe pupils' actions, expressions, and body language to aid in decision-making. In the United States, it is required that all students in the majority of grades take a specific number of examinations in a set number of topics. Additionally, the states must enforce their own testing regimens so that schools, students, and instructors are all held accountable for their performance. These all generate a tonne of data that must be processed. There has been an automatic promotion system for young children in India recently and still now. Now, everything could change. In this regard, a recent comparison study was conducted between the educational systems used in the USA and the NEP in India.[253] Big Data approaches are required in schools and colleges due to the issue of information storage, analysis, and dissemination between students and professors. Such technologies are necessary for student enrollment, teacher evaluation, and cost analysis in Indian institutions and universities.[26]

With a number of programmes, big data in education has established itself on the international arena. The following are a few of them: (a) the OECD's Program for International Student Assessment (PISA), which assesses young students' abilities and believes that the "highest performing education systems are those that combine quality with equity"; (b) the big business houses and the finance industry have greatly benefited from Big Data and data analytics; and (c) the use of autopilot mode by pilots and the use of GPS-less navigation by drivers are both results of Big Data systems.[27] In light of the HRD Ministry's projected modernised educational system, this essay examined the opportunities and constraints that Big Data brings to students, instructors, and other educational stakeholders.

3.4 System Design for Big Data Education

By the New Education Policy, the Human Resources Development (HRD) of India is reforming education at all levels, from kindergarten to PhD programmes (NEP).[14–15] The following are the objectives of the national educational policy: 1. To provide students with the knowledge and skills they need. 2. To end the labour deficit in industry, academia, science, and technology. 3. To encourage equity, affordability, access, quality, and accountability. 4. To implement a new "5+3+3+4 design" in the curriculum and pedagogy of the educational system. This will mark a significant departure from the "10+2" school education system that has been in place since the National Policy on Education of 1968. In general, metropolitan pupils are better able to adjust to technology advancements in schooling.[28]

Sujatha and Natarajan presented a plan in Ref.[16] for integrating big data into the NEP-based educational system. The design has made sure that the curriculum is industry-focused by incorporating the technology and skill requirements of the workplace in schools and institutions. To improve the course syllabus and content, an industry-institute partnership is also suggested in the area of big data systems.[29] The Smart Cities are ideal for this kind of setup because professionals from business and academia may visit these locations with ease. To guarantee that students successfully integrate into the industry and the corporate world, the curriculum must be relevant to the industry and must expose students to the relevant skill-sets required by the sector.[30]

The System Design has taken into account both the current and future GSAT series satellites created by ISRO, in addition to the traditional optical fibre networks. This would make it easier for students to use big data technology, not just in cities but also in the far-flung hill regions of the North East, Meghalaya, and J&K. It should be mentioned that, in addition to education, big data is also utilised to better understand India's resources, the changing climate, traffic patterns, pollution, etc. by using the massive amounts of information and photos produced by India's Earth Resources Satellites. The layout will enable educational institutions to implement digital classrooms.[31] There is capacity for classrooms that are adapted to the requirements of the students. This is going to be useful for schools where there are more pupils than teachers, which is the case in rural areas and inaccessible tribal regions of India. Technology has improved learning's humaneness. Devices, facilities, and equipment are simpler to deliver in smart cities since they are specifically created for high-speed connectivity via optical fibres throughout the entire city.[32]

Students should advance in the traditional educational system simply based on their age and periodic exams. Even though they may succeed, children with exceptional talent often remain in the same classes as their less talented colleagues. Educators can continuously assess student achievement using big data platforms, and kids may be promoted quickly. Improving student performance is the fundamental goal of integrating Big Data and other digital technologies in the education sector. By examining their deficiencies using the available data, managers can enhance the teaching-learning process by analysing student behaviour in the classroom. The development of education and literacy for the impoverished group of society will benefit from the Big Data design. Figure 4 depicts a Flow Diagram for the NEP-based Big Data education.[33]

Some of the relevant educational technologies for the urban environment are as follows:

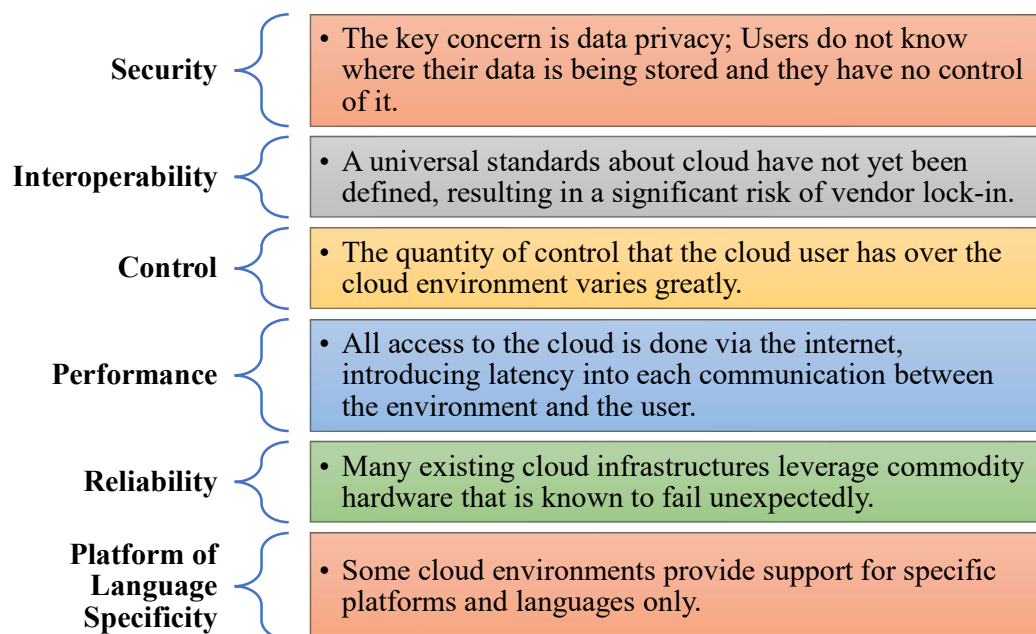**Figure 4: Flow Diagram for NEP-Based Big Data Education**
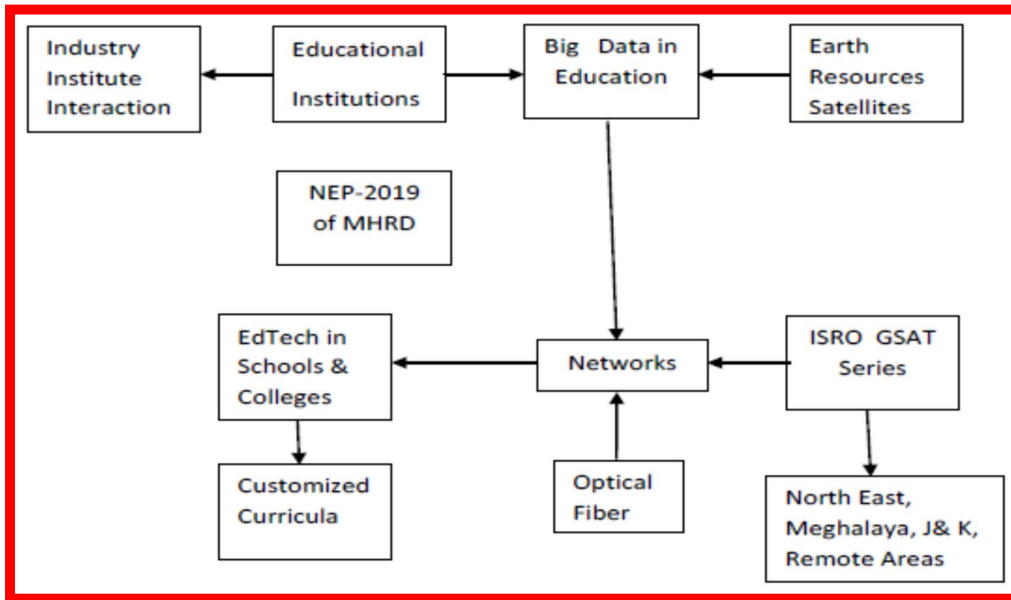
3.5 Risks and Challenges

Increased security risks: When company data is transferred to the cloud, the cloud provider now shares responsibility for data protection. The consumer of the cloud must expand their trust boundaries to include the external cloud in order to use information technology resources remotely. Setting up a security architecture that measures such a trust boundary without adding vulnerabilities might be very challenging. [34]

Lower operational governance control: Customers who use the cloud typically receive a lesser level of governance control than those who use on-premise IT resources. This could increase hazards related to the cloud management practises of the cloud provider as well as the reliance on external connections for cloud-to-cloud communication.[35]

Restricted portability between cloud providers: Public clouds are frequently owned to different degrees since the cloud computing industry lacks clear industry standards. It can be difficult for cloud customers to switch between cloud providers if their unique solutions depend on certain ownership environments.[36]

The Carnegie Mellon University Software Engineering Institute has identified "Barriers to Adoption" for cloud computing. Using the cloud service can be advantageous and helpful if these issues can be resolved with the service provider.[37]

Figure 5. Challenges of Cloud Computing

Security	• The key concern is data privacy; Users do not know where their data is being stored and they have no control of it.
Interoperability	• A universal standards about cloud have not yet been defined, resulting in a significant risk of vendor lock-in.
Control	• The quantity of control that the cloud user has over the cloud environment varies greatly.
Performance	• All access to the cloud is done via the internet, introducing latency into each communication between the environment and the user.
Reliability	• Many existing cloud infrastructures leverage commodity hardware that is known to fail unexpectedly.
Platform of Language Specificity	• Some cloud environments provide support for specific platforms and languages only.

3.6 Benefits and Opportunities of Big Data and Cloud Computing in Education System

Some of the benefits resulting from Cloud computing and Big Data in education, esp. in the Smart Cities environment are as follows:

- Increased academic performance of students to increase chances of admission to reputable colleges or universities.[38]
- Accurate assessment of students by studying their progress continuously.
- Better performance of educational institutions.
- Creation of innovative digital learning techniques and new educational patterns, such as curriculum that is tailored to student needs.
- Identification of problem-areas of students using Big Data along with Adaptive Learning.[39]
- Use of conventional class rooms along with online learning process.
- Knowing just a few of the subjects that are taught in schools is insufficient. The HRD Ministry, schools, parents, and other stakeholders have worked together over time to promote the holistic development of students. The goal is to provide students with extracurricular activities and skills to complement their academic training.[40]
- With big data, schools can monitor students' development across a range of subjects on both an individual and group level and create solutions that will help them advance by giving them new skill sets.[41]
- Tens of thousands of people desire to pursue higher education throughout India. It's challenging for colleges to accommodate everyone. Nonetheless, they are able to enrol thousands of students in distance learning or online programmes thanks to Big Data and other educational technologies. Annamalai University in Tamil Nadu has been offering online courses for a while. BITS, Pilani and its many campuses have some sort of distance learning programme at the All India level.[42]

- Educational initiatives. We don't need as many classrooms and teachers, which also lowers the cost of schooling. Urban areas make it simpler to hold specialised student training sessions.
- There are currently too many tests and pupils in both schools and colleges. The amount of teachers caring for them in this situation is not excessive, though.[43]
- There may only be two or three teachers in certain village schools. It is not feasible to grade a large number of pupils with a small number of teachers. Teachers now have a quicker and more practical approach to grade the student body thanks to big data. [44]

4. CONCLUSION

In the present day, cloud computing is a breakthrough technology. It is a developing discipline that assists the IT industries in making optimum use of their hardware and software resources and facilitates service-oriented, on-demand network access to quickly scaled resources with the promise of lowering operational and capital costs. It has broadened the scope of computing applications and gives users access to a worldwide platform. Every industry, from business use to educational purposes, benefits from it. Future usage of traditional classrooms (four-walled) appears to be declining. Students will get a lot from this. Institutions with poor financial standing can afford high-end computing resources. Following the debate above, it is obvious that the Indian education industry will flourish if the cloud is successfully implemented.

In the framework of the NEP of the HRD Ministry, this study has made an effort to assess Big Data and other Educational Technologies for urban environments in order to improve student performance in K–12 classrooms and colleges and in PhD programmes. Students in Smart Cities, where cutting-edge ICT infrastructure is anticipated, will find this research to be of great interest. In India, big data has not yet fully developed. Even so, technology will continue to be a significant factor in how schools and institutions teach and learn in the years to come. When fully operational, the current and future ISRO GSAT satellite series will contribute significantly to the Big Data education in Smart Cities and will be backed by Bharat Net alongside the traditional optical fibre network. Also, the NEP will benefit from the distinctive qualities of 5G technology. Big Data education will make sure that excellent students can enrol in advanced courses in a fast-track mode while giving less-than-ideal pupils more flexibility.

5. LIMITATIONS OF THE STUDY

- Given India's variety, we think Big Data alone won't be able to address issues with the educational systems. Over dependence on big data will be counterproductive in our multilingual nation.
- The AICTE has approved hundreds of engineering institutes in India. Yet, the majority of colleges do not turn out graduates with the high level of expertise in big data technologies needed by business.
- Big Data needs to address scalability and storage problems.

- Big Data, by its very nature, deals with enormous amounts of data. A normal college or university in India has a number of thousand students. Data loss could therefore be a risk, particularly in the context of cloud storage.

- Errors like data losses can happen when maintaining numerous datasets of the full student population across multiple categories. They can be quite expensive to fix, and they are particularly prevalent in cloud storage systems. To deal with problems like data mistakes, we need a lot of expertise.

- Data safety is an important problem in Big Data.

REFERENCES

1. A techno-economic feasibility study. http://www.holtecnet.com/index.php?id=57. Date accessed: 2013.
2. PCAST, executive office of the president, the president's council of advisors in science and technology report. 2010, 1–148.
3. Hey T, Tansley S, Tolle K. The fourth paradigm: data-intensive scientific discovery. Microsoft Research: Redmond, Washington. 2009.
4. Strawn GO. Scientific research: how many paradigms? *EDUCAUSE Review*. 2012; 47(3), 26–34.
5. AICTE, policies for UG and PG, All India Council for Technical Education. https://www.aicte-india.org/. Date accessed: 2017.
6. Smart data collective. https://www.smartdatacollective.com/. Date accessed: 2019.
7. GOI, Govt. of India, Smart Cities Mission, Ministry of Housing and Urban Affairs. http:// smartcities.gov.in/content/innerpage/smart-city-features.php. Date accessed: 12/04/2017.
8. GSAT-11 satellite to boost Internet connectivity in North East: Manoj Sinha. Telecom News. https://telecom.economictimes.indiatimes.com/news/gsat-11-satellite-to-boost-data-connectivity-in-north-east-manoj-sinha/66951883. Date accessed: 05/12/2018.
9. UGC: Govt. of India, Report of the higher education in India: issues related to expansion, inclusiveness, quality and finance. University Grants Commission: New Delhi. 2019.
10. Allerin. https://www.allerin.com/blog/4-ways-big-data-is-transforming-the-education-sector. Date accessed: 01/01/1970.
11. Dede C. Data-intensive research in education: current work and next steps. Computing Research Association: Arlington, VA. 2015; 1–20.
12. Sujatha R, Natarajan K. New education policy of India: a comparative study with the education system of USA. *International Journal of Humanities and Social Science Invention*. 2019; 8(6), 01–09.
13. MHRD, National Education Policy: NEP, 2019, Draft National Policy, Ministry of Human Resources Development, Government of India. https://MHRD.gov.in. Date accessed: 18/11/2019.
14. NEP, new education policy-2019, news in educational tips & tricks, https://niosdelednews. in/2019/06/02/new-education-policy-2019-pdf-download/. Date accessed: 02/06/2019.

15. White house office of science and technology policy. Investing in America's future: preparing students with STEM skills. 2015; 1–9.
16. Sujatha R, Natarajan K. Integrating educational technologies into engineering education in Indian technical universities. *Journal of Advanced Research in Dynamical and Control Systems, USA*. 2019; 11(10), 125–131.
17. Sujatha R, Natarajan K. Artificial intelligence for educational applications in the context of Prime Minister's New Education Policy (NEP). In: International conference on recent trends in computing, communication & networking technologies. 2019; 4.
18. Muntazir Abbas. ET telecom. https://telecom.economictimes.indiatimes.com/author/479234376/muntazir-abbas. Date accessed: 30/10/2013.
19. Features of 5G technology. http://freewimaxinfo.com/5g-technology.html. Date accessed: 2019.
20. How big data helps build smart cities. Tech Alpine, K Dnuggets News. https://www.7wdata.be/ article-general/how-big-data-and-internet-of-things-builds-smart-cities/. Date accessed: 2015.
21. Thomas Erl with Zaigham Mahmood and Ricardo Puttini, "Cloud Computing Concepts Technology & Architecture - The Prentice Hall Service Technology Series", pp. 26.
22. Wikipedia, "Cloud Computing", Available online: http://en.wikipedia.org/wiki/Cloud_computing, Last Access: 4th August, 2017, 2:56 p.m.
23. "Cloud Compuitng Gudelines", Available online: https://solutionsreview.com/cloud-platforms/freecloud- computing ebooks, Last Access: 16th May, 2017, 02:04 p.m.
24. Wikipedia, "Cloud Computing", Available online: http://en.wikipedia.org/wiki/Cloud_computing, Last Access: 4th May, 2017, 2:56 p.m.
25. "NIST Cloud Computing Standards Roadmap", Available online: https://www.nist.gov/document- 4641, Last Access: 16th May, 2017, 10:10 p.m.
26. "The NIST Definition of Cloud Computing", Available online: http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf, Last Access: 4th August, 2017, 3:30 p.m.
27. Tuncay Ercan, "Effective use of cloud computing in educational institutions", Available online: http://www.sciencedirect.com/science/article/pii/S1877042810001709,Last Access: 5th June, 2017, 10:00 p.m.
28. Delic, K. A., & Riley, J. A., "Enterprise Knowledge Clouds: Next Generation KM Systems?", International Conference on Information, Process and Knowledge Management, Mexico, 1-7 February 2009, pp. 49-53.
29. Rajeev Piyare and Seong Ro Lee, "Towards Internet of Things (Iots): Integration of Wireless Sensor Network to Cloud Services For Data Collection and Sharing", International Journal of Computer Networks & Communications (IJCNC) Vol.5, No.5, September 2013, pp. 59-72.
30. Shin-ichi Kuribayashi, "Reducing Total Power Consumption Method in Cloud Computing Environments", International Journal of Computer Networks & Communications (IJCNC) Vol.4, No.2, March 2012, pp. 69-84.

31. "CAREER: Secure and Trustworthy Provenance for Accountable Clouds", Available online: http://www.nsf.gov/awardsearch/showAward?AWD_ID=1351038,Last Access: 28th July, 2017, 6:30 p.m.

32. Nidal Hassan Hussein and Ahmed Khalid, "A survey of Cloud Computing Security challenges and solutions", International Journal of Computer Science and Information Security (IJCSIS), Vol. 14, No. 1, January 2016, pp. 52-56.

33. Tuncay Ercan, "Effective use of cloud computing in educational institutions", Available online: http://www.sciencedirect.com/science/article/pii/S1877042810001709 ,Last Access: 5th August, 2017, 10:00 p.m.

34. Anjali Jain & U.S Pandey, "Role of ClouD Computing in Higher Education", Available online: http://www.ijarcsse.com/docs/papers/Volume_3/7_July2013/V3I6-0242.pdf,Last Access: 5th September, 2017, 10:15 p.m.

35. "Cloud Computing in Education, a Microsoft U.S. education whitepaper",Available online: http://www.aicte-india.org/downloads/CloudComputinginEducation.pdf,Last Access: 10th June, 2017, 8:00 a.m.

36. "Cloud Computing in Education, policy brief 2010", Available online: http://iite.unesco.org/pics/publications/en/files/3214674.pdf, Last Access: 7th June, 2017, 8:55 a.m.

37. Google, "About Us", Available online: http://www.google.com/about/company/history/, Last Access: 28th May, 2017, 10:00 p.m.

38. "Roundup of Cloud Computing Forecasts and Market Estimates, 2016", Available online: https://www.forbes.com/sites/louiscolumbus/2016/03/13/roundup-of-cloudcomputing- forecasts-and-market-estimates-2016/#513d2e4f2187,Last Access: 17th May, 2017, 10:00 a.m.

39. "Cloud computing services", Available online: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_cicce_use&lang=en, Last Access: 17th May, 2017, 10:30 a.m.

40. "Cloud Computing as an Emereged Technology", Available online: https://josephvermeille.wordpress.com/tag/statistics-on-the-rate-of-adoption-of-cloud-computing/, Last Access: 17th May, 2017, 09:10 p.m.

41. Mobile Phone Subscriber Statistics, Available online: http://www.btrc.gov.bd/content/mobile-phonesubscribers- India-january-2016, Last Access: 18th May, 2017, 09:10 a.m.

42. "Role of Cloud Computing in Education", Available online: https://www.ijircce.com/upload/2014/february/21_Role.pdf, Last Access: 18th May, 2017, 11:00 a.m.

43. Thomas Erl with Zaigham Mahmood and Ricardo Puttini, "Cloud Computing Concepts Technology & Architecture - The Prentice Hall Service Technology Series", pp. 45.

44. Thomas Erl with Zaigham Mahmood and Ricardo Puttini, "Cloud Computing Concepts Technology & Architecture - The Prentice Hall Service Technology Series", pp. 47.