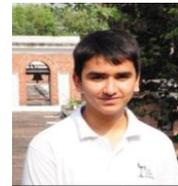


**ANALYTICAL STUDY OF THE IMPORTANCE OF BIG DATA APPLICATION IN THE EDUCATION SECTOR IN INDIA**

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**ABSTRACT**

Nowadays big data allows education institutions to conduct organizational analytics and perform new business intelligence using the learning management system. This data visualization helps to evaluate the performance indicators in teaching, administration, and research. The education sector has faced several challenges in teaching effectiveness, student acquisition and student retention, and ineffectiveness in storing or processing or analyzing the data. Big data is employed in widely different fields; this research article aims to study how education uses big data. This research paper analyses the literature of the research about big data in education in the time interval from 2010 to 2021 then review the process of big educational data mining, the tools, and the applications of big data in education. This paper, with the help of these applications, explores the idea to improve the education process. Two methods are applied to validate the education process, and many parameters are discussed to complete the research. This study aims at the influence of big data in education and how the education system will be enhanced by using big data analytics. Further, the study uses exploratory research design to determine the challenges and needs of big data in the education sector. The study concludes that big data with Hadoop provides effective results in the education sector in India.

**Keywords**—*Big Data in Education, Educational Data Mining, Data Mining Tools, Big Data Applications, Hadoop*

**1 INTRODUCTION**

Big data is related to a large amount of data, but it is more than the only size it is characterized by four Vs: volume, variety, velocity, and veracity. Where volumes indicate the size, in 2014, there were 2.4 billion users of the Internet. That number became 300 million internet users in 2017. By 2019 there are over 4.4 billion internet users, which is representing an 83% increase in the number of people using the Internet in the last five years. Variety

refers to all types of data, structured or unstructured get generated by humans or by machines.<sup>(1)</sup> Velocity refers to the speed of generating and processing data. Veracity refers to the noise and abnormality in generated data, and how much one can trust this data when decisions need to make on this data. Big data can be applied to many fields such as healthcare, administration, or security. It can revolutionize intelligence in transport, energy, finance, and education, which is what we intend to study here. In general, there is a need for using big data, which is given many advantages, such as helping to predict performance for example coronavirus modelling and behaviour for COVID-19 are predicted with big data.<sup>(2)</sup> In this research, we will highlight on education field because Big Data is already used widely in education. According to up to 2016, there was increasing in several articles that study big data in education by up to 50%, and since then, the number has fallen an average of 6%, so there is a need to do more research in this field.<sup>(3)</sup>

Over a few decades, the emergence of big data analytics helps entrepreneurs to explore the data manually to carry out useful patterns in the market. Big data analytics has derived various opportunities for institutions, policymakers, educationalists, administrators and learners.<sup>(4)</sup> The opportunities are enhanced knowledge flow and learning success over the organization, cross-collaboration over the institutions become comfortable and learning effectiveness would be enhanced, cost reduction over organizing financial performance become possible and academic risk would be lowered.<sup>(5)</sup> Through traditional application software, big data won't be processed. Hence, it requires cloud-based technologies like Hadoop and Spark to my huge amount of data. This big data approach offers organizations an effective way to stay strong and active in the business. In addition to this, the Hadoop platform has received attention as it renders various advantages to institutions and learners.<sup>(6)</sup> This research aims to review big data applications in education. We attend to explore how it improves the education process. Furthermore, review the stakeholders, the process of educational data mining, and the tools. Finally, we summarize the applications they applied to big data in the education field.<sup>(7)</sup>

## 2 STATEMENT OF PROBLEM

Nowadays big data analytics has been used in education. Besides various opportunities the educationalist experience some challenges to deploy big data analytics. The challenges are enunciating data flow, training practitioners and decision-making and actions.<sup>(8)</sup> Retaining data for the analysis is a significant challenge for the deployment of educational analytics. It is difficult to access required data from the incorporated database system and hard to create a data warehouse for all institutions. Unstructured data and lack of quality can lead to essential issues. To create an understanding of the system among the educators, the trainees need to involve in learning the system which takes more time.<sup>(9)</sup>

The education sector has faced several challenges in teaching effectiveness, student acquisition and student retention, and ineffectiveness in storing or processing or analyzing the

data. Big data is employed in widely different fields; this research article aims to study how education uses big data. This research paper analyses the literature of the research about big data in education in the time interval from 2010 to 2021 then review the process of big educational data mining, the tools, and the applications of big data in education. <sup>(10)</sup> This paper, with the help of these applications, explores the idea to improve the education process. It would be difficult for educators and learners to offer information in an informative way. However, big data influence the education sector effectively. To sort out these challenges, this study is proposed. <sup>(11)</sup>

### 3. LITERATURE REVIEW

To find the literature related to the research, this research follows the method to find relevant literature, which is three phases: planning, conducting the review, and documenting the result of the review. First step: planning, to define the articles, including the term “Big Data for Education,” <sup>(12)</sup> this research depends on a search in Digital Library with customizing the years of publishing from 2015 to 2021. The finding was about 521,716 items. Second step: conducting the review, according to this step aims to identify the relevant research, select main studies, Assess the quality of it, and synthesize data. Last step: documenting the result of the review. <sup>(13)</sup>

#### A. *Shaping the education sector*

Educational institutes like universities, colleges, and schools have carried a huge amount of data. It can be determined to focus on which enhance the operational effectiveness of the educational institutions. Student exam results and the development of educational needs are highly relied on changing educational requirements and will be computed by using statistical analysis. Big data provides a way for a revolutionary system where students can learn in innovative ways. <sup>(14)</sup>

The education sector has adopted big data techniques where the educational institutions, students and parents acquire effective advantages. It is used to evaluate the academic performance of the student over exams. Each student produces unique data which can be evaluated for determining the student's behaviour to develop a learning environment. <sup>(15)</sup> Big data analytics administer the student activity like classroom performance, curricular activity interests, favourite subjects and time to complete the exam. Because of the processing data-driven system, educators can receive advantages from big data analytics. This data-driven approach helps the institutions develop a learning experience based on student ability, learning capability and preference. Multiple programs will be predicted which will motivate a person to determine what they need to learn. Many reports will be produced about their future and predict what they want to do in future. After receiving feedback from the learning experience for students educators can enhance teaching skills. <sup>(16)</sup>

### ***B. Career prediction***

Big analytics helps to determine the student performance report and will enhance the authority to know about the student's strengths and weaknesses. Such a report will implicate some solutions to a student about the areas to be focused on in future.<sup>(17)</sup> If the student focuses on learning a specific subject, the student must be motivated and choice should be recommended to prefer what they want to follow. Big data is found in all different fields and render valuable information to human beings. However, a significant decision will be taken to enhance the present scenario and determine predictive big data analytics.<sup>(18)</sup>

Educational data mining is defined as evolving concepts that focus on creating methods for determining the type of data which obtains from educational settings. This method is used to understand the students they learn.<sup>(19)</sup> Educational data mining deals with applying and researching computerized methods to evaluate the patterns in educational data. Due to the high volume of data, the patterns would be difficult to analyze.<sup>(20)</sup> The process involves in educational data mining projects is data mining, data acquisition, pre-processing and validation. These methods are obtained from data mining, psychometrics and machine learning, information visualization and modelling. Educational data mining and learning analytics are similar in the aspects of processes, data sources, data types and objectives.<sup>(21)</sup> Educational data mining and learning analytics quietly differ in the approaches to the process of applying data analysis. It also emphasizes the application of data mining approaches which include association rule, classification, and clustering. These approaches support students and teachers in learning and analyzing the process.<sup>(22)</sup>

### ***C. Learning Analytics***

Learning analytics has received enhanced attention as it provides various advantages to the institutions of higher education and enhances student retention, student success and provide accountability. Learning analytics focus on managing the capacity of the analytics such as acting on predictions and forecast behaviour.<sup>(23)</sup> The objective of learning analytics is to enhance prediction over time. It allows schools and teachers to utilize the educational opportunities to the level of needs. It enhances the efficiency of approaches in interpretation and mining to enhance the understanding of learning and teaching. It tends to enhance the education of each student effectively.<sup>(24)</sup> It aims at managing a large amount of data generated by the students in academic activities. This learning analytics focus on student success in their education. It is the phenomenon of collecting, analysing and reporting the data about learners in terms of understanding the learning.<sup>(25)</sup>

Increased development of big data analytics becomes significant for the organization to manage the measurement and management processes. The education sector has become significant to determine the data for the enhancement of academic and learning activities.<sup>(26)</sup> Learning and academic analytics are the processes of analytics in the education sector. This learning analytics is the process of collecting data about the learners and tends to learn more effectively. It deals with enhancing the learner's success.<sup>(27)</sup>

Academic analytics aims at the development of the processes, resources and workflows of the institution over the use of academic, learner and institutional data. It also focuses on enhancing organizational effectiveness. Due to enhance accreditation, competition, and regulations the adoption of academic analytics is increased. In the education sector, a large amount of data has been collected but they are not been analyzed properly.<sup>(28)</sup> This higher education leadership is highly focused on the significant and critical decisions as per insufficient information when that could be attained by analyzing the data. Business analytics, predictive analytics and action analytics are taken into consideration in big data analytics. In the academic domain, learning analytics focused on learning processes, learners and learning behaviours.<sup>(29)</sup>

#### **4. RESEARCH METHODOLOGY**

Qualitative research has been applied to this study. Qualitative research is used to acquire knowledge of people's reasons, opinions and motivations. It offers an extensive view of the problem and provides ideas for making quantitative research. It also determines the thoughts and opinions about the problem. However, this qualitative research will add perceptions to the existing problem statement. Such research is called exploratory research.

- ***Data collection:***

To evaluate the results, the researcher may use primary method and secondary methods.

- ***Primary method:***

The primary method of the research is used to gather data by performing interviews, surveys and observations. By doing these methods, the researcher will experience confidentiality issues. It also aims at market research, experimenting and observations. However, these methods are not applied to this study.

- ***Secondary method:***

Secondary is the approach of gathering data from the sources like articles, magazines, newspapers, and journals. This method prefers existing sources of distinct researchers. This method has been applied to this research for data collection. The data has been collected from the literary sources of researchers and introduced an effective solution for education using big data analytics.

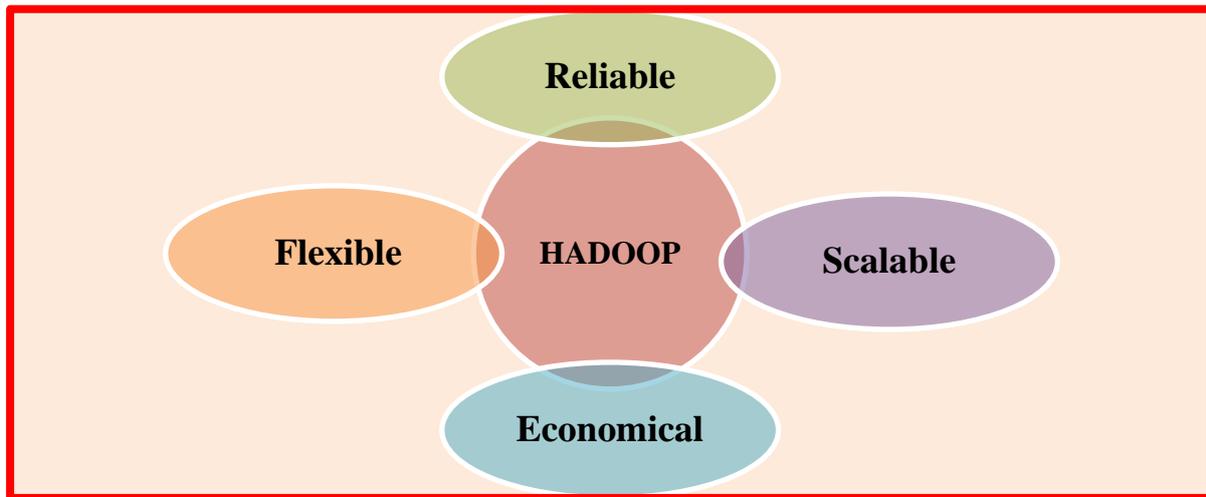
- ***RESEARCH DESIGN:***

In this research, the exploratory research design has been applied. Exploratory research can able to determine the research questions and not offer final solutions to the existing issues. To determine the problem, the research designs offer an effective understanding of the problem. From this research, the researcher can able to decide their decisions as per the findings of new insights and new data. This research explores problems and offers new solutions when there is no existing research made."

## 5. RESULTS AND ANALYSIS

The study findings revealed that Hadoop platforms are used in the education sector to manage huge amounts of data efficiently.<sup>(30)</sup> To enhance the process, the education sector uses batch and stream processing for storing the data. Hadoop is the platform which allows the distributed processing of data using a single programming model.<sup>(31)</sup> The characteristics of the Hadoop platform are reliable, scalable, flexible and economical.

**FIGURE 1: CHARACTERISTICS OF THE HADOOP PLATFORM**



*Source: Author*

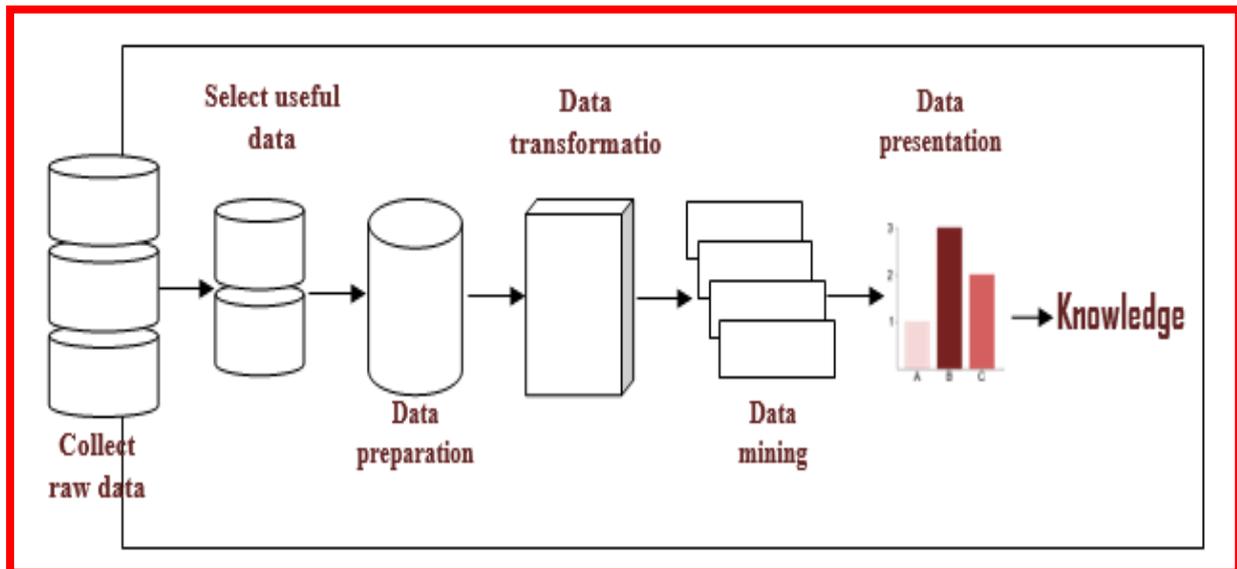
Hadoop is the modern big data processing framework used for extensive storage and effective scalability.

The results of the study predict that Big data technologies using to extract valuable and meaningful information from vast volumes of a wide variety, veracity, and fast-growing data.<sup>(32)</sup> Using big data to develop different types of applications for education data mining, and extract knowledge from those data help education sectors such as schools and universities to be smarter. Education is different when compared with different sectors like a business that uses big data in terms of the difference in participants who involve in the education data mining process and look from different views at their specific mission, vision, and objectives.<sup>(33)</sup> The education data consider big data because the volume and the variety it's daily produced a large amount of data about the student, their activity and their interaction with learning systems or the platforms of learning, the activities of learning, and course information which differs from one another, also different information that helps to improve the education processes quality.<sup>(34)</sup>

### 5.1 Big educational data mining process:

Educational data are collected from many different sources in different education environments such as a traditional classroom or different learning management systems it could be the records of students, their behaviours, exams performance, social forum, etc. demographic data, IOT data administrative data.<sup>(35)</sup> A huge amount of data can produce from the education sector. Mining big educational data as any big data mining follow the steps of data mining a) collect raw education data, b) select the useful data, c) data cleaning and preparation, d) data transformation: normalize the data, smoothing and any other process to make the data ready to mining, e) Data mining: extract a pattern from data, f) evaluation and presentation the data, and g) discover the knowledge by interpreted the result. Figure 2 shows the process above.<sup>(36)</sup>

**FIGURE 2: BIG EDUCATIONAL DATA MINING PROCESS**

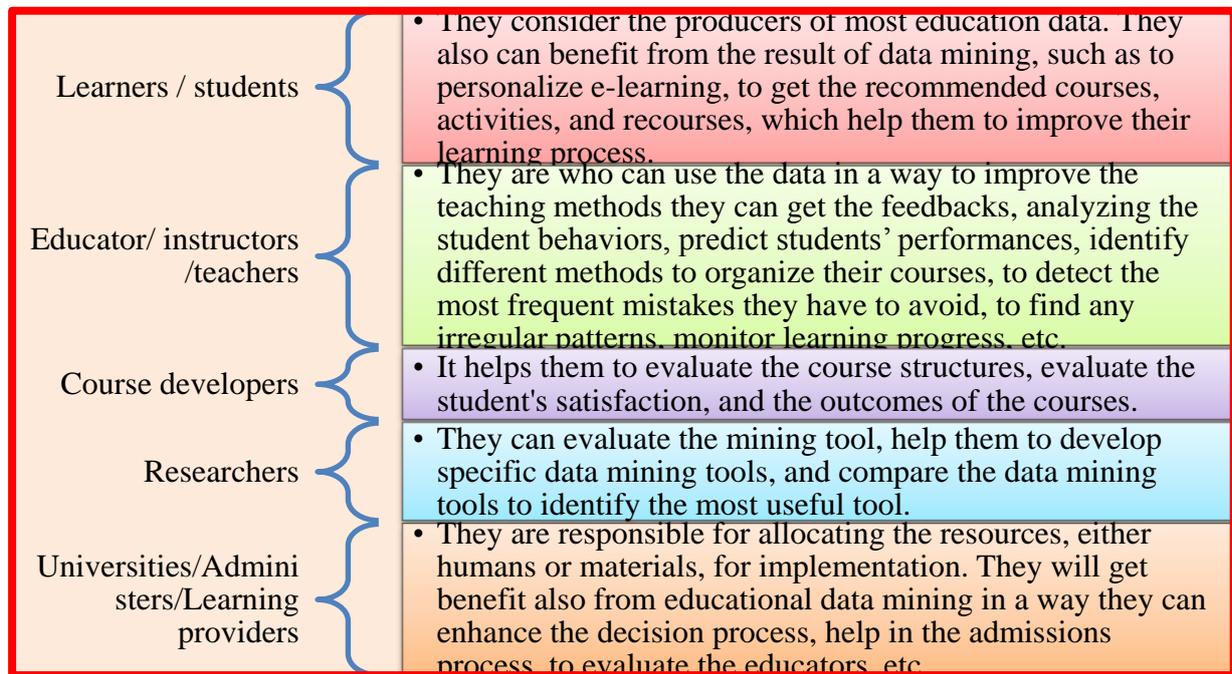


*Source: Author*

### 5.2 Educational data mining stakeholders:

The educational data mining stockholders are the people who produce the raw data and get benefit from the knowledge extracted from the mining process. It may be the same data, but every stakeholder can use it depending on its objectives. The stakeholders are:

**FIGURE 3: EDUCATIONAL DATA MINING STAKEHOLDERS**

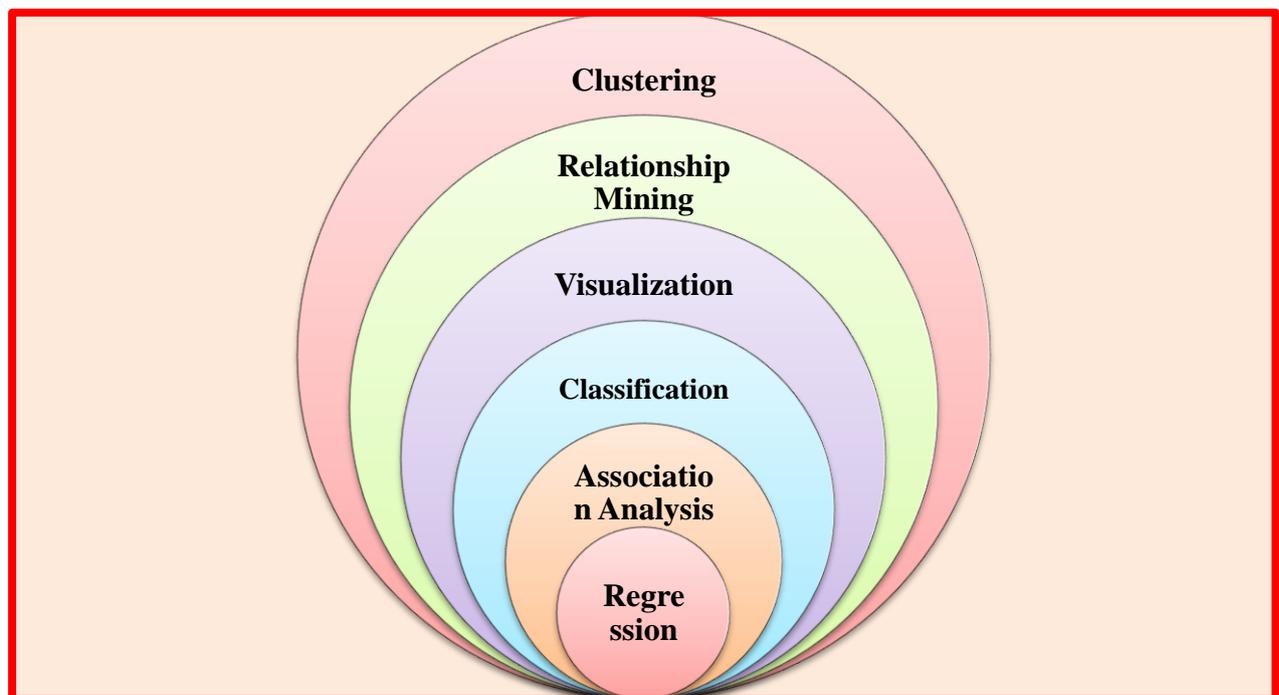


Source: Author

### 5.3 Data mining tools

The most popular data mining establishment in the educational field are:

**FIGURE 4: DATA MINING TOOLS**

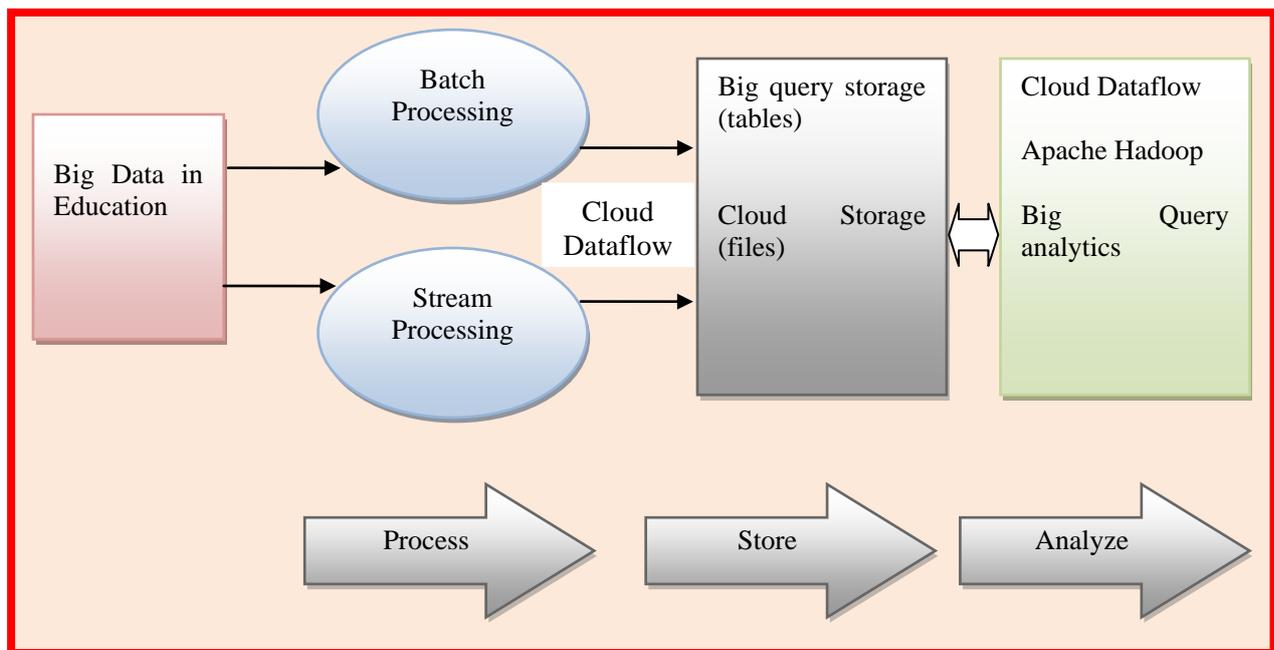


Source: Author

## 6. PROPOSED APPROACHES OF BIG DATA TECHNIQUE IN EDUCATION

The proposed approach of big data technique in education is implemented in Apache Hadoop in the system process. This proposed approach uses batch processing and stream processing in processing educational data.<sup>(37)</sup> Batch processing is the approach of evaluating the blocks of data over a certain period. Hadoop Map Reduce is an effective platform for processing data in batches. In the educational sectors, the stream of data has been divided into blocks of data and performs the function by using the Hadoop platform. Stream processing tends to process the data in real time as they determine the condition in a small amount of time. It enables us to give data into analytics tools and receive analytics results. These two types of processing are used to enhance the performance of educational data. With the help of cloud data flow, this process will be accessed efficiently.

**FIGURE 5: PROPOSED APPROACHES OF BIG DATA TECHNIQUE IN EDUCATION**



*Source: Author*

### A. Storing

To store the data, our study uses cloud storage to store the files. The educational data can be stored in the cloud in the form of files and tables. The tables are stored in big query storage and files are stored in cloud storage. The students prefer the online learning system and the cloud will help to store the data efficiently. The above process will be accessed in the education system to store the data.<sup>(38)</sup>

### B. Analysing

The big data Hadoop is used in the education industry for accountable, economical and reliable purposes. There some challenges that exist in the education sectors are enhancing

evaluation and monitoring, creating industry ready education system, getting trained teachers for enhancing quality education, making the system more accountable and understanding the industry demand. By having these challenges in the education sector, Hadoop has the potential to overcome these challenges with help of big data.

***Student acquisition optimization:***

We can find unemployment in many countries. If we ask the human resource department, they will answer that they are not finding the right candidates. Through campus drive, they can find hundreds of candidates and fill the vacancies. Many companies state that employers are experiencing issues in getting the right resources. With the help of the Hadoop system, the industry may conduct sentiment analysis on the students who are involved in the drive. Many students are focusing on different domains as they are studying. They are paying more attention towards the engineering stream. As a result of this intention, it may lead to depression and unemployment. By having a Hadoop solution, they must analyze before can select any branch for study. It can be done by being determined by posts and shares of social media data. They must take feedback from the teachers and need to know their interests.<sup>(39)</sup>

***Teaching effectiveness:***

Many instructors are not able to give their best in teaching. It is significant to determine that instructors enhance their performance and reward them. Inadequate teaching effectiveness is the expressed sentiment about the instructor will allow the educational institutes to take necessary steps. The institution may reward the instructors who have successful students. With the help of big data, educational institutes determine the trends in the industry

***Student retention:***

Many educational institutions could not able to retain the students for longer. The students leave the educational institution early and the problem exists within the colleges, schools and institutes. The educational institutes should determine the posts and analyze the trends and feedback to serve the student better. The significant challenges in education are to evaluate how the data is stored, processed, and used for future outcomes. An essential issue experienced by educational institutions is the number of student transfers or dropouts. The challenge in the high education sector has been restricted to business intelligence and students can make decisions. This becomes ineffective in enhancing student retention and affects student performance.

**7 CONCLUSION**

This study highlights how big data influence the education sector. There are some challenges in the education sector such as data privacy, data security, ineffective decisions, unable to capture or access or storing data. These issues can be solved using the Hadoop framework and big data. It also uses batch and stream processing for processing the data. cloud storage is used for storing the data and the Hadoop platform is for efficiently analyzing

the educational data. By using this framework, the education sector can enhance student retention, improve teaching effectiveness, transform into effective decision thinking and actions and student acquisition optimization. In this research, we discuss the big data means to the education field, the stakeholders, the process of mining big data, and the tools. Also, review the related work and summarized the application applied big data mining techniques on educational data. For future research, the practitioner can integrate Hadoop for enhancing the performance of the education sector.

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