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ANALYSIS ON APPLICATIONS IN THE SMART CAMPUS: A SURVEY ON FUTURE TEACHING AND LEARNING ON HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

Higher education's purpose and value are rapidly evolving as a result of technological progress and the widespread availability of data. In higher education institutions around the world, data mining and advanced predictive analytics are increasingly being used to perform tasks such as student recruitment, enrollment, prediction of student behaviour, and the development of personalised learning schemes. Big data and cloud computing impact on higher education is examined in this chapter. Using a systematic literature review and qualitative content analysis, the authors establish their position on the benefits, challenges and opportunities of using big data and cloud computing in education. We are conducting a comprehensive literature review in order to identify trends, classify research themes, identify potential future research avenues, and point out potential limitations. We conducted a systematic review of all 40 primary studies published between the years of 2014 to 2019. There has been an increase in education-related big data studies over the last two years, according to the findings of this study. Current studies on big data in education cover four main research themes: learner behaviour and performance, model-based educational data warehouse, system enhancements, and integration of big data into curriculums. Research on student behaviour and performance has been the primary focus of most big data educational studies.

1. INTRODUCTION

Both urbanisation and the migration of people from the countryside are increasing rapidly. Consistent population growth raises a slew of environmental issues, chief among them an uptick in the world's demand for natural resources. There has been a lot of attention paid to the sustainability of the environments in which people engage in a variety of activities, including the consumption of resources. ICT-aided sustainability studies can be a significant challenge to large parts of the city, as well as to a wide range of socioeconomic and cultural differences. Teaching and learning on a university campus or in a smaller setting are the focus of this chapter. As large as a city, a university campus usually represents an environment that is difficult to replicate in another ecosystem. The principles and experiences of "smart cities" are used to transform conventional campuses into "smart campuses," where people in positions of power can benefit from the incorporation of new technologies or innovative developments.

Data can be generated by many devices that connect to the Internet, allowing them to communicate with other people. Moving from an outmoded city to a progressive one, on the other hand, will necessitate significant time and financial resources. Prior to focusing on the smart city environment, it is necessary to address a wide range of issues that will necessitate

the collaboration of experts from various fields in order to best utilise available resources.

The campus of a university fits the previous definition, making it an ideal starting point for this research. A large administrative staff, many students, and a wide geographic distribution make it ideal for demonstrating smart campus techniques or processes. Concern over what constitutes a "sustainable and smart campus" has not gone away.

In order for a smart campus to be useful in recognising events and needs, universities must base their decisions on the data they have about their students and administrative structures. A shorter timeframe for data processing and performance is required, however, for traditional decision-making. The problem is that traditional research platforms can't keep up with the influx of data.

The foundation of a smart campus is the use of tools that can detect and respond to student needs based on current trends. As a result, the current trend in data science is to use big data because of its superior results. Platforms like these provide more cost-effective, flexible, and time-saving options for student data management and data gathering. There are two ways to analyse data: BI and data mining. It's critical to keep as much data as possible on a smart campus while looking for alternative cleaning methods to avoid affecting the effectiveness of decision-making.

2. LITERATURE REVIEW

The massive amount of data necessitates high-capacity storage systems. A data type or heterogeneity can be described as having a variety of data. Both structured and unstructured data can be utilised (images, video, emails). With big data analytics, unstructured data can benefit. Velocity is a term that describes the speed at which massive amounts of data can be accessed. Data from web server logs is available in almost real-time (Sivarajah, Kamal, Irani, & Weerakkody, 2017).

In this situation, educational institutions are not an exception. Online courses, teaching, and learning generate enormous amounts of data in the educational setting. Teachers now have access to students' academic performance, learning patterns, and instant feedback thanks to big data. Students' motivation and satisfaction are boosted when they receive timely and constructive feedback, and this has a positive effect on their performance (Zheng & Bender, 2019).

Holland, upcoming year, 2019 Teachers can use academic data to evaluate their teaching methods and make adjustments based on the needs and requirements of their students. Many educational websites have been created, and students can choose from a variety of courses based on their own preferences. Acquisition and technology are the keys to educational advancement.

Big data and management theory were once again the focus of a study by the researchers Camargo Fiorini Seles Jabar Mariano and Sousa Jabbour Jabbour (2018). The education sector has yet to conduct a comprehensive review of big data, despite previous studies on a wide range of topics. This study's goal is to conduct a comprehensive review of the primary research, trends, and themes, as well as limitations and potential future directions, in the field of big data in education. This study has the potential to make a significant contribution to the development of educational big data.

Table 1 Description of Research Themes

Studies Themes	Description	References
Learners behavior and performance	Data frameworks, adaptive learning, big data pedagogical approaches and teaching and learning analytics were all examined in these studies.	(Cantabella, Martínez-España, Ayuso, Yáñez, & Muñoz, 2019)
Modeling and educational Data Warehouse	Studies that used Hadoop and data warehouses to model and analyse big data. It examined the use of cloud computing and cluster analysis to make educational data more accessible and easier to process.	(Pardos, 2017; Petrova-Antonova, Georgieva, & Ilieva, 2017;
Improvement of the educational system	In-depth research into the use of statistics, measurements, and other ICT tools. Focused on training and its various consequences. It incorporated a ranking system and tracked how students interacted with various websites in an effort to make the system more effective.	(Gupta & Rani, 2018; Martínez-Abad, Gamazo, & Rodríguez-Conde, 2018)
Integration of big data into the curriculum	There have been a number of studies that have explored the educational implications of big data.	(Sledgianowski, Gomaa, & Tan, 2017)

The term "theme" refers to an overarching concept or subject matter that has been the focus of a number of different studies. Focusing on the text's central idea can help you gain real insight and analysis. A single word or a series of words can convey a theme. In this study, researchers looked at four different aspects of big data and classified them (Table 1).

3. DEFINITIONS OF SMART CAMPUS AND SMART UNIVERSITY

The term "smart campus" has previously been used to describe digital online platforms that manage university content or a collection of strategies aimed at enhancing university students' intelligence. This distinction must be made absolutely clear. The term "smart campus" refers to the combination of hardware and software needed to provide cutting-edge, context-aware services and applications to students and faculty at universities. Additionally, "smart universities" refer to the hardware and software used to create tools for the university's mission.

• Enhance the processes of higher education's teaching, learning, and assessment.

• Foster research and innovation.

• A common vision among university stakeholders, as well as knowledge transfer from within the community, are key to this strategy (There are also non-profit organisations and research institutes as well as citizens, businesses and governments that are all involved in the educational process).

When compared to concepts like "smart cities," campuses and universities equipped with cutting-edge technology stand out. Smart campuses/universities, on the other hand, are structured in a manner similar to smart cities, with six smart areas:

• **Smart governance.** Involvement of university staff and students is encouraged through this mechanism.

• **Smart people.** Attendance at specific events or participation in the teaching and learning process is a contributing factor.

• **Smart mobility**. As a smart university campus grows, so does its need for transportation systems that are both environmentally friendly and capable of providing intelligent services.

• **Smart environment**. There are many smart solutions in this field that are capable of monitoring, protecting, and acting on our environment while also managing our resources sustainably. For example, waste, water use, and air quality can all be monitored with a smart environment system. Systems for controlling and monitoring the consumption, production, and

distribution of energy on a campus also appear frequently in this field.

• **Smart living**. Health, safety, and user behaviour are just some of the things it keeps an eye on as part of its day-to-day responsibilities on the campus. Consequently, the following are possible outcomes of smart home services:

– Room occupancy and student attendance can be estimated.

– Access to classroom and laboratory equipment should be restricted..

– Context-aware applications and interactive teaching services are both needed.

Figure 1. Fields and technologies most relevant to an intelligent campus.

For a smart campus/university, the various fields and technologies involved can be summarised in Figure 1. This circle contains the six smart fields that were previously mentioned. The Internet of Things (IoT), Augmented Reality (AR), CPSs, and UAVs are a few of the most critical technologies to address these six smart fields (Unmanned Aerial Vehicles).

4. METHODOLOGY

4.1 Features of Big Data and Functions of Data Platform

Big data is a virtualization technology that uses distributed computer structure to mine massive data. It is characterized by four aspects: large data volume,

multiple types, value emergence and high efficiency. As an emerging digital technology and management mode in IT field, big data has important implications and reference value for intelligent and scientific decision-making. Attaching importance to and making full use of big data technology and grasping key links such as data collection, analysis and processing can effectively promote the speed and height of the construction of smart campus.

In the construction of smart campus, data is the most important element, which is also one of the innovations of smart campus. As an independent and important asset, data should be comprehensively collected (perceived), orderly transferred and unified in structure. Only through aggregation and analysis can its intrinsic value be reflected and value can be continuously generated. In addition, in the construction of smart campus, the supporting role of big data platform is particularly important, which should be equipped with information col- lection, data storage, data analysis and processing, data exchange and sharing and other functions. The construction of big data platform covers two parts: infrastructure and application support. It is the aggregation center of all data on campus and the core of smart campus data processing.

4.2 The Difference between Data Mining and Data Analysis

"Big data" describes a collection of data that conventional software tools cannot capture, manage, or process in a reasonable amount of time. New processing modes are needed in order to improve decision-making power as well as insight and discovery capabilities as well as process optimization capabilities in this massive, high-growth information asset. Data mining, rather than hardware and software advancements, is the primary focus of big data technology.

Analysis of large amounts of data involves using appropriate statistical analysis methods to extract useful information and draw conclusions, as well as studying and summarising the data in great detail. The quality management system also plays a role in this process, and data analysis helps people make decisions so that the right actions can be taken.

Both data mining and exploration can be used to refer to the process of mining data. In the context of database knowledge discovery, it is a stage in which algorithms are used to search through large amounts of data for information that has been hidden from human eyes. Information retrieval, machine learning, and pattern recognition are all part of the data mining process that is typically associated with computer science and statistics.

5. PROPOSED SYSTEM

5.1 **Proposed framework**

Complicated technologies like Apache Hadoop and NoSQL databases can be made more accessible to a wider range of people through open source software like BD storage and network bandwidth provided by cloud computing. The fact that BD and Analytic tools are getting cheaper and easier to use only serves to emphasise this point. When businesses and educational institutions begin to use these tools, they will be able to achieve better results while also utilising their resources more effectively. Stakeholders' expectations, accountability, and an increased desire for evidence-based guidance are among the factors cited for the rise of BD in higher education. When it comes to making progress toward this goal, it's important to identify appropriate technology platforms and relevant technological talent, such as data scientists. There has been a dramatic shift in the role of data in the business world since the arrival of data scientists who can mine terabytes of previously unusable data and extract actionable insights. Students who need to be able to work long hours or live far away can take advantage of virtual and online learning systems, which allow for greater flexibility in terms of both time and distance. Society and politics are increasingly placing demands on the educational system, such as the need to increase the number of students enrolled in particular fields of study and the requirement to provide graduates with a set of skills and attributes in demand by the workplace.

There are many ways that BD can influence higher education practise, including student experiences, academic programming, scientific proof judgement, and tactical responses to shifting economic trends. To put it another way, BD is capable of transforming difficult-to-understand data into actionable knowledge. For improving one's judgement, M. I. Baig claims that BD is a cost-effective method. The reference provided a conceptual framework to describe BD in HEd along four components in order to organise the available literature and construct a study technique to assist in

the establishment of a set of investigation options (Learning Analytics, Institutional Analytics, and AA and information Technology analytics). The diagrammatic representation of it is shown in Fig. 2 below.

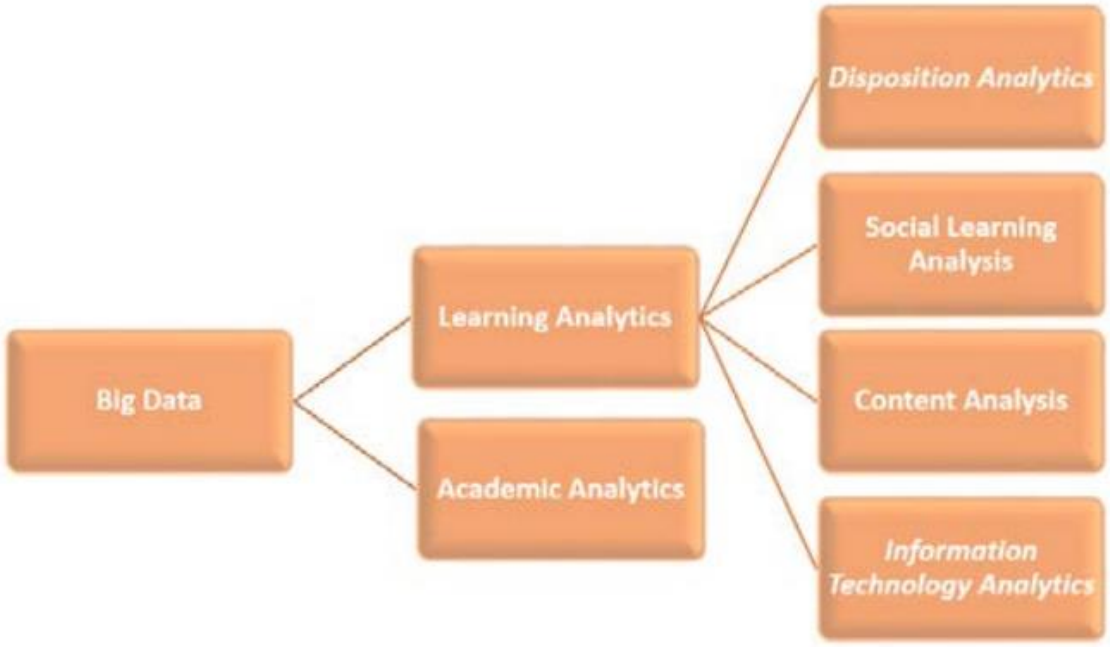

Fig. 2. Components of BD.

Effective use of data necessitates the ability to analyse a wide range of data sets regardless of where they originate. The implementation of BD in HEd necessitates the consolidation of data stored in silos within institutions, the management and governance of the data, and the protection of sensitive information across databases.

Data gathered from a variety of sources within an institution can be used to make better decisions about essential business and technological needs, reducing redundancy and wasting valuable time. Despite the difficulty of integrating data from disparate systems, the resulting insights and improved predictive modelling capabilities are well worth the effort. Using data from a variety of sources, the current study's researcher creates an efficient framework for utilising large amounts of data. A diagram of the proposed framework for this study is shown in Fig. 3.

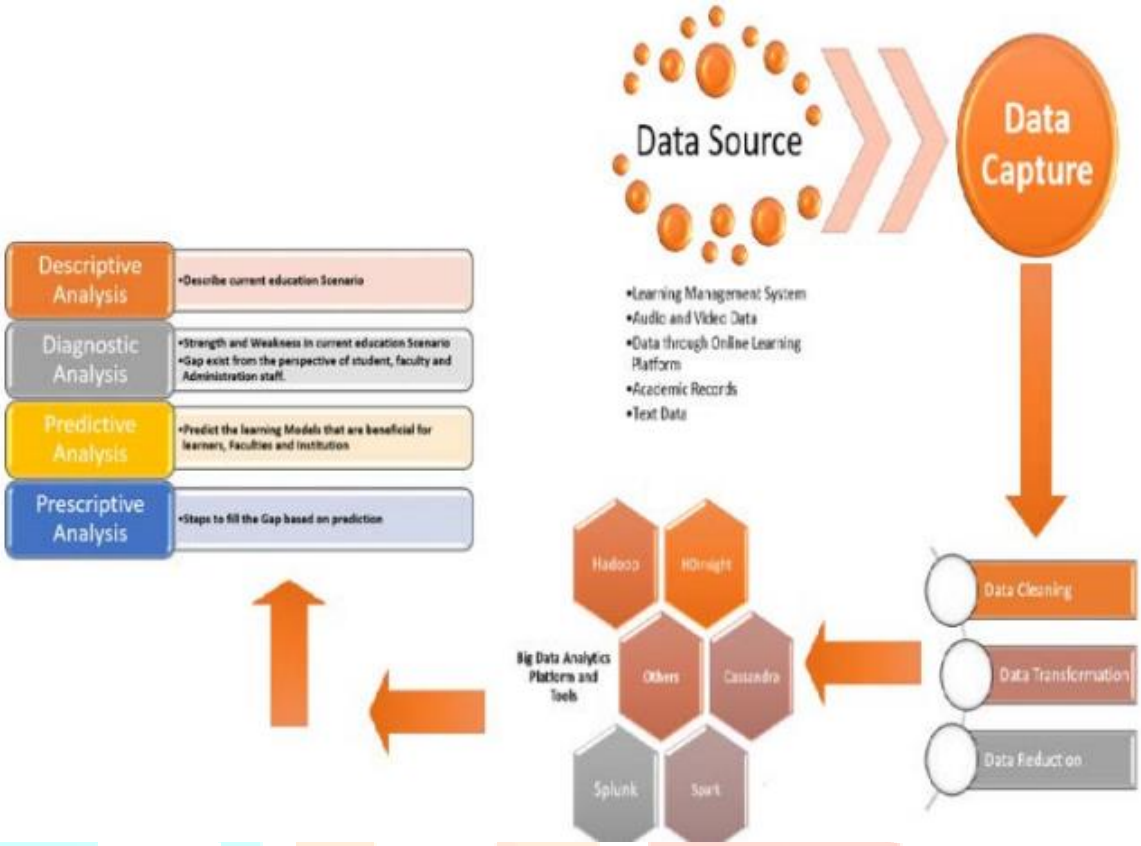

Fig. 3. Proposed Framework for Analyzing BD in HEd.

5.2 BD and education

Learning processes for students graduating from colleges and universities are frequently criticised for not providing the necessary knowledge, relevant tools, mindsets, and values for success in the workplace; however, the huge data produced by the infrastructure and various systems of today's digital campus, which includes data produced or collected from the network applications of campus, various other internal applications used for serving various needs of the (HEd). Despite the prevalence of LMS, mobile, and other devices among HEd stakeholders, it is rare for higher education to make use of them to learn more about the pressing issues that face or may affect today's educational institutions. When it comes to the use of promising techniques such as BD, HEd is still in its infancy. Students, parents, and taxpayers all have a stake in ensuring that higher education institutions can thrive in every way possible, and this has led to an increase in the number of useful ideas and proposals that can be summarised under the category of increased transparency and accountability. Since BD and LA in HEd are the most efficient ways to gather and evaluate data on these topics, students and the educational setting both benefit greatly from their use. Additionally, it offers educators information on educational content as well as activities that can be used to improve the teaching and evaluation process. Due to strained university budgets and increased cost-consciousness, analytics in higher education (HEd) is becoming increasingly popular. Students are also becoming more demanding as stakeholders, asking proof that their tuition is being spent wisely.

CONCLUSION

The explosion of data necessitated the development of BD as a tool for handling large amounts of data from multiple sources. Academic institutions with strong R&D departments could benefit greatly from this technology. Consider the long-term effects of implementing BD analytics, which has the potential to broaden the teaching-learning orientation of higher education institutions. Teachers and administrators are urged to help the system and gain value from practical applications such as creating a culture of data use for educational decision-making, asking critical questions about market deals and suggesting the most beneficial features, engaging IT departments in data collection, application planning and starting with a pilot programme. While saving money and attempting to incorporate teaching abilities, educational institutions can make better decisions. This framework is intended

to help educational institutions and the sector as a whole develop innovative teaching-learning philosophies that will improve student achievement and the quality of education provided.

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