Sustainable Competitive Advantage of Big Data Analytics in Higher Education Sector: An Overview

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Abstract. The new technology paradigm of big data captured by flooded data from billion devices is the hottest buzzword trending in this 21st century. Big data is generated of data at high volume, high velocity, and in a variety of format that is complex (veracity) which necessitates analytical procedures and active management of data to extract meaningful insights. Similarly, big data is also known as a game-changer proficient of transforming the way businesses operate in different organisation for sustainable competitive advantage. This paper introduces an integrated overview of big data technology in the higher education sector and discusses how the application of big data analytics can create value for Higher Education Institutions to sustained competitive advantage. As the education sector is operating in an increasingly complex and competitive environment, given the growing advantage of the educational institutions as one of the sources of revenue that boost the economy.

1. Introduction
In today’s current information age, we are living in big data has become an essential part of most of our everyday lives. The new integrated innovative technology expectations have reached an all-time high as there is an explosion of data generated daily. Many of the organisations such as science, healthcare, engineering, business, and ultimately society at large are seeking affluence with big data today to transform their organisations for competitive advantage among their peers in the same environment. Big data does not have any specific definition (an efficient way of applying big data). Therefore, big data can be defined as a collection of data that is so complex and large which can be challenging to process and analyse using on-hand database management tools application.

The goal of big data is primarily to manage, process and analyse its characteristics. These are the 5 Vs of data-linked aspects consisting of volume (i.e., the amount of data), Velocity (i.e., the speed at which data is generated), Variety (i.e., formats of data from various sources, i.e. either unstructured or structured), Veracity (i.e., disorderliness and complexity of data) and Value (i.e., the unknown insights of data) [1]; [2]. As a result, Big data capabilities could bring sustained value by assessing performance and founding competitive advantages [3].

The wisdom of mining big data analytics in higher education institutions is to enable better evidence-based competitive advantage in innovative teaching-learning orientation. Although the application of big data analytics in higher education is relatively new, the technology of big data analytics has the capabilities to strengthen and contributes to institutions [4]. With the potentials of big data analytics, education institutions could tackle some of its challenges, as institutions are under
increasing pressure from both national & international economic, competitive advantage globally and social & political change. Universities have vast amounts of data [5][6]. These datasets are abundant and growing, but this data resource is often underutilized. Therefore, it could be said that the Higher education sector has access to a large amount of data which can be used to make effective decision making for improved education quality [7].

2. Big Data Analytics in Higher Education Institutions

The new integrated innovative technology expectations have reached an all-time high as there is an explosion of data generated daily. This has emerged big data. There are many studies done about the use of big data in several fields regarding its availability of data, cost, applicability, significance, and security [8]. Nevertheless, few publications report the integrative usage of Big Data in higher education [9][10]. Higher institutions have access to a staggering amount of data, hosted in disparate sources, and governed by different processes. Thus, big data have the potential to harness the institutional data which can improve the future of the education sector, particularly in decision making.

Big data analytics can be measured in education institutions as a comprehensive technical IT source by considering a set of mechanisms which will lead to sustainable competitive advantage [11]. Analytics of big data architectural component can be used to transform data of the higher education from numerous sources and formats into meaningful insights through the analytics tools of big data. The architecture of big data component is comprised of five layers. These layers include data, data analytics, data aggregation; information exploration; and data governance [12].

Data layer covers the sources data necessary to propose insights which will provide repetitive processes of operations. Thus, data layer can support any challenges for a better decision making within the institutions; analytics: Analytics layer aids with the analysis and visualization of data in HEIs for enhancing learning and the environment in which it takes place [10]; data aggregation: Data aggregation layer is the processes of data management resulting from various sources of data such as data from communication channels, sizes, formats (unstructured and structured). Therefore, data aggregation layer aims to analyse data coming from this variety. However, this Variation of incoming data is one of the significant challenges in executing Big data technology; Information exploration layer delivers outputs production such as real-time or near real-time data by examining the reports, visualization of the reports that can derive meaningful insights; Data governance layer involves the understanding of data management, its lifecycle, and security & privacy management. Dominant data management is taken into account as the governance, standards, policies, tools, and processes for data management. Data life-cycle management is the process for information management through its lifecycle while Data security and privacy management is the concept whereby big data analytics provides innovativeness for monitoring, auditing, and protection to data [13].

Consequently, each of the architecture components of big data can be predictably to have the capability of big data application within the institutions of education. Therefore, from the complexity view of big data analytics [2] and sustained competitive advantage as reported by [11] and [14], the research intends to use UTAUT model to comprehend the expected capabilities of big data analytics to create sustained competitive advantage and business value[15]. For example, big data can enable the maximization of students learning success as sometimes some students are faced with the indecisive choice of appropriate primary course to take and making the instructors wonder how to customize learning paths so that no student is left behind.

3. Big Data Innovative Teaching-Learning for sustained competitive advantage in Higher Education Institutions Concept.

Currently, higher education institutions are mostly in the phase of developing new approaches to reconsider how they accomplish their mission to sustain competitive advantage. However, due to political and Economic pressures have increased the scrutiny of the quality of the higher education institutions, especially in terms of labour costs such as funding from the government and change in
government policy, access and continued growth of students, leadership change, economic sustainable development and updates of institutional policy are mostly the challenges the higher education institutions faces [16]. Educational data analytics and mining could make the unnoticed, unseen and therefore unavailable data visible as illustrated in Figure 1. It can be seen that the higher education sector is increasingly growing. The projection shows how, based on the individual country perspective, the sustainability patterns are expected to evolve.

![Figure 1. increase in population in higher education institutions](image)

Today, most executives recognize their organization’s importance of data as a new digital innovation which is seen as a necessity due to growth and evolvement of sustainable competitive advantage in higher education system [17]. Competitive advantage is the degree to when an organisation incorporates an idea and at the same time, produces a strategy that no current or future rivals adopt [18]. Likewise, an organization is said to have a competitive advantage if an innovation strategy is being adopted concurrently by no current competitors and it is not yet able to replicate the benefits of this strategy [18]. Therefore, when an organization beats its competitors, a competitive advantage is achieved.

Even though big data is still new and much less understood, it has the potential to offers organisations much bigger growth capability than traditional technologies [19]. With the emergence of big data analytics in higher education institutions, the advantage of big data analytics could cover all aspect of teaching-learning orientation that can provide business value for higher education. Big data analytics integrative functions can use several statistical analysis and machine language to recognize risks, issues and opportunities in the system. Thus, education can become dynamic and cheaper, learning approaches can be improved, and operations can be given [20]. Consequently, the performance of education can be enhanced. Big data technology can be argued for its compatibility with sustainability particularly in the phase of multidimensional environment, intelligent distribution of sources, integrated practices, priorities of the expertise [21]. Big data capacity for higher education also covers, among others, monitoring & regulation, modelling & visualizing, and Predictive Analysis.
i. Monitoring & regulation: Institutions of higher education report and comply with various internal (institutional audit) and external regulatory (government) requirements, especially on data privacy and protection. Organisations who are interested and involve in creating BDA services must assimilate both their internal and external data [10]. Consequently, it is essential for HEIs to provide data & reports related to teaching-learning, curricular aspects, student performance, achievement and academic progression, faculty research & productivity, innovation, and governance as the significant compliance requirement (big data academic and learning analytics. Connecting the dots). Big data analytics, for example, can enable the student performance tracking, extracurricular interactions and results of social behaviour by creating a profile that can be mapped with student profiles from the institution network to suggest the most relevant major faculty courses. Moreover, teachers can have instant access to student performance based on generated customised learning ways.

ii. Modelling & visualizing: Big data can be incorporated to improve the upkeep of the wide variety of HEIs functions to reduce cost. Similarly, to develop a new strategy for academic transformation and excellence, given the growing importance of the education sector as a source of revenue for boosting the economy. Academicians can introduce to take data mining methods to analyse data stored in its cloud-based platform grounded on big data to predict student behaviors such as students’ interaction, engagement, and pervasive knowledge transfer to students and community in general. Likewise, visualisation can be integrated as there is a shortage of courses to be offered on traditional and online platforms shortly [10]; [22]. Higher education institutions could implement big data on-campus infrastructure and operations such as daily reports of the help desk, capacity, maintenance statistics, bandwidth usage, security and other relating internet usage to generate modified automated dashboards to support decision-making. As a result, institutions would have alternatively reduced the cost. Consequently, higher education institutions can distinguish visualisation of students’ retention rates, graduation rates, students’ debt and tuition fees.

iii. Predictive analysis: predictive analysis is putting in place assumptions about unaware of future events. Predictive analytics could be used in a wide variety of situations in higher education institutions. As reported by [23], big data uses an algorithm to replace human decision making by predictive analytics as big data analytics is classified into academic and learning analytics. For learning analytics, Dashboards have been replaced by learning analytics provide immediate feedback on student needs, academic needs and goals [24]. Academic analytics is the combination of institutional data, automated algorithm analysis, and predictive modelling to create intelligence with which teaching-learning orientation can change the organizational pattern of higher institutions [25]. Academic analytics summarizes all the activities in higher education that affect the administration of the educational institution, including; research projects, management and allocation of resources. Academic analytics can facilitate decision-making through the development of innovative predictive models for the transformation of the education system and as a result, making academic analytics a vital necessity for the future of higher education institutions [26].

4. Research Design
For this study, the research intends to use a qualitative research design. Semi-structured interview approach will be used as the research methodology, which will provide an opportunity to triangulate as the primary source and materials from the literature review as the secondary source. The methodology intends to employ for respondents open-ended deliberations, fixing future analysis by questioning significant explanations made by the respondents. This method of qualitative research attests, and most appropriate particularly when the phenomena to be researched are not accurately understood or known, and researcher desires to get an in-debt understanding perspective from respondents experienced in the aspect [27].
Therefore, the research requires respondents having a thorough understanding of the diverse views of the topic. Snowball sampling in qualitative research enables respondents for selecting experience compatible with the research objective by recommendations from the respondents [28]. Semi-structured interviews which will be informal with open-ended questions will be used. The respondents will comprise academicians, administrators, big data experts, Academic Solution Provider, IT Specialist in Big data and IT Administrator in both public and private higher education institutions. In other to achieve those above, the research intends to employ the Unified Theory of Acceptance and Use of Technology model and Nvivo software for the analysis of the research topic.

4.1. Unified Theory of Acceptance and Use of Technology
Venkatesh, Davis and Morris developed a Unified Theory of Acceptance and Use of Technology in 2003 with four determinant constructs that may influence and affect the intention of innovation acceptance. These constructs include performance expectancy, effort expectancy, social influence, and facilitating conditions [29]. Performance expectancy is the degree to which an organisation assumes that adopting a technology would help to achieve the expected benefits or improvement to which it was conceived is success expectation. Effort expectancy is the degree to which an organisation expects that adopting a change will be related to ease of use. Social influence is the extent to which an organisation perceive others to believe in the use of technology/innovation. Finally, the facilitating conditions are to the degree that an organisation believes that its organisational and technological framework facilitates the adoption or introduction of technology [30] such as the involvement of senior managers and governments and the presence of experts and skills necessary to use technology (see Figure 2).

![Unified Theory of Acceptance and Use of Technology](image)

**Figure 2.** Unified Theory of Acceptance and Use of Technology [31]

5. Conclusion
The explosion of data has emerged big data for processing massive with a variety of data. Its potentials can be of great benefit to higher education institutions. Higher institutions must explore the future impact of adopting big data analytics which can extend the teaching-learning orientation for institutions. Executives could recommend that the administrators and educators help the system and gain value from practical applications, such as; to create a culture of data use for educational decision-making, keen with data users by asking critical enquiries about market deals and suggest the most beneficial uses and features, engage IT departments in data collection and application planning and begin with focused sections where data can be useful, confirm success and expand into new areas. As a result, helping institutions saving cost, efforts to integrate pedagogical skills and effective decision making. This framework is intended to enhance the development of innovative teaching-learning orientation for the performance of education institutions as an insightful contribution of making curriculum design for instructors and learners in education in particular and sustained competitive advantage of the education sector at large.
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