



BIG DATA FRAMEWORK FOR EDUCATIONAL INSTITUTIONS – A REVIEW

¹Velmurugan.L,

Department of Computer Science, Ambo
University, Ethiopia

²Sivanesan.D

Department of Information Systems,
Mizan Tepi University, Ethiopia

ABSTRACT

The information of institutions is increasing enormously in the context of students, instructors, and researches etc., Institutions of higher education deals these information by their own approaches. There are plenty of software mechanisms are available to handle the information of educational institutions. Big data and analytics applications are needed in all activities of educational institutions in the context of instructions, information system, administration etc, already being felt and should not be ignored. This paper reviews potential help of Big Data in educational institutions, reveals the challenges that today's educational institutions facing and this paper concludes by outlining a framework that will be useful to handle information and decision making processes by using Big Data in educational institutions.

Key words: Big data, Information system, Information technology

1. Introduction

Institutions of higher education are operating in an increasingly complex and competitive environment. They are under increasing pressure to respond to national and global economic, political and social change such as the growing need to increase the proportion of students in certain disciplines, embedding workplace graduate attributes and ensuring that the quality of learning programmes are both nationally and globally relevant. In addition, different stakeholders are expecting higher education institutions to in a timely manner to these demands, albeit with declining government funding, declining support from business and private sectors, growing regulatory demands for transparency and accountability (Hazelkorn, 2007), declining admissions rates due to increasing tuition and upsurge in high schools dropout and increasing operational costs (Thornton, 2013).

Big Data is an emergent field of research that uses data analysis to inform decisions. It is currently being explored mostly in business, government and health care due to the growing plethora of data collected and stored in these environments. Big Data research is mainly aimed at

examining how to efficiently aggregate and correlate massive volumes of data to identify recurring behavioural patterns and meaningful trends instead of cataloguing the status quo.

In spite of the growing changes happening in the environment of higher education, the role of data in helping addressing contemporary challenges is often overlooked. As learning technologies continue to penetrate all facets of higher education, a plethora of useful ‘data traces’ are generated. These data can be utilised to inform institutions of higher education to adapt better in response to changes happening within and outside their environments.

Big Data presents to Institutions a good framework for efficiently utilizing the vast array of data in shaping the future of higher education (Görnerup, O., Gillblad, D., Holst, A., & Bjurling, B., 2013).

2. Empirical Investigations

Virtual Private Networks (VPNs) are used by some federal agencies to allow their employees to access data remotely (e.g., to securely access an agency’s private network via a public network such as the Internet while working at home). Additionally, other countries use such technology for researcher access. Similarly, Databrary, a digital library, provides a platform for researchers to share and access video data. (<https://nyu.databrary.org>). Some of the data, in the identified form, are available to the public, and identifiable video data and other contextual information are available to authorized researchers. Although the non-public portions of Databrary require informed consent and promises to best protect the identity of participants, it is not anonymous or de identified.

Big Data can impact higher education practice, from attractive students experience to improved academic programming, to more effective evidence-based decision making, and to strategic response to changing global trends. Big Data potentials to turn complex, often unstructured data into tortious information. (Hilbert, 2013) pointed out that Big Data transports a cost-effective prospect to advance decision making. In order to systematise the available literature and develop a research design to help edging set of approaches for investigation, (Daniel and Butson 2013) proposed a conceptual framework to describe Big Data in higher education along four components [see Figure 1].



Figure 1: Conceptual Framework

The University of Otago Technology Enhanced Analytics Framework (Figure 3) describes a wide range of administrative and operational data gathering processes aimed at assessing institutional performance and progress in order to predict future performance and identifies potential issues related to academic programming, research, teaching and learning.

Institutional analytics: Institutional analytics refers to a variety of operational data that can be analysed to help with effective decisions about making improvements at the institutional level. Institutional analytics include assessment policy analytics, instructional analytics, and structural analytics. Institutional analytics make use of reports, data warehouses and data dashboards that provide an institution with the capability to make timely data-driven decisions across all departments and divisions. **Information technology (IT) analytics:** IT analytics covers usage and performance data that helps with monitoring required for developing or deploying technology, developing data standards, tools, processes, organisational synergies and policies. IT analytics aim at integrating data from a variety of systems—student information, learning management and alumni systems, as well as systems managing learning experiences outside the classroom.

A key application of learning analytics is monitoring and predicting students' learning performance and spotting potential issues early so that interventions can be provided to identify students at risk of failing a course or program of study. Several learning analytics models have been developed to identify student risk level in real time to increase the students' likelihood of success. Examples of such systems include Purdue University's Course Signals system and the Moodog system being used at the course level at the University of California, Santa Barbara, and at the institutional level at the University of Alabama. Higher education institutions have shown

increased interest in learning analytics as they face calls for more transparency and greater scrutiny of their student recruitment and retention practices (Romero C. R., and S. Ventura. 2010).

3. Conceptual Framework

Corporate–academic partnerships are increasing (Leydesdorff&Etzkowitz, 2001); however, to attract and sustain these partnerships, corporations require institutions of higher education to demonstrate a commitment to the utilisation and development of advanced technologies that are likely to support applied research outputs and potentials for knowledge transfer and commercialisation (Mok, 2005) as illustrated in figure 2. At the same time, these global changes are mounting on the institutions of higher education; new technologies continue to have a significant impact on academic careers as research and teaching become more reliant on these technologies (Economist Report, 2008). Over the last decades, a digital revolution associated with developments in new technologies such as ubiquitous computing devices, flexible class room design and Massive Open Online Courses is radically reshaping the mode and accessibility of learning and teaching.

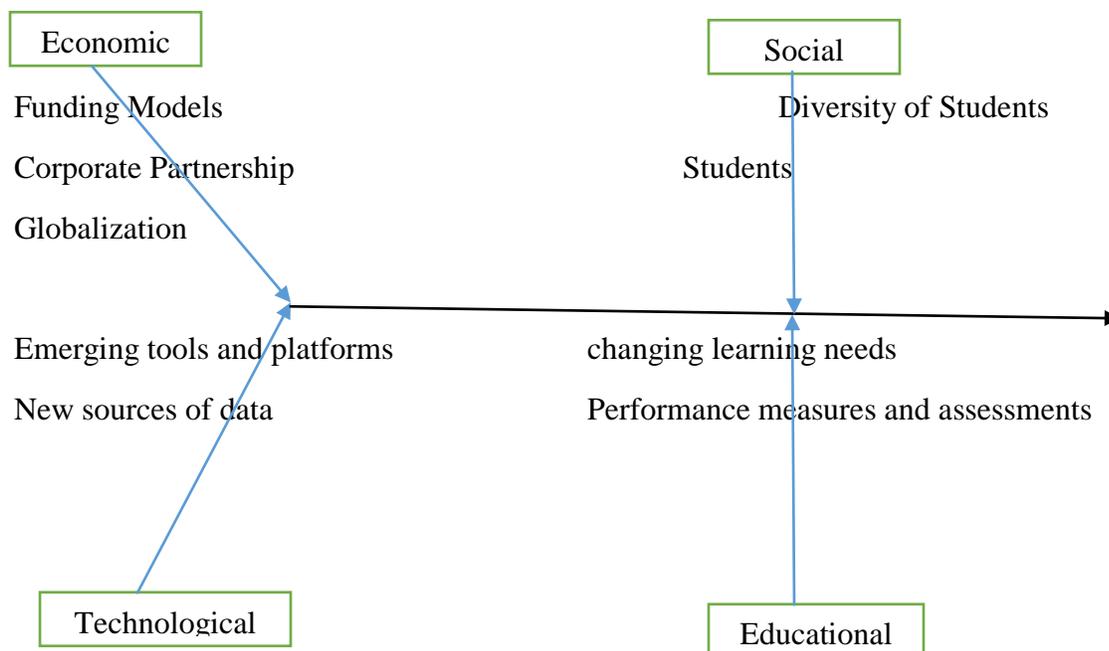


Figure 2: Current Trends affecting institutions of higher education

The potential information and challenges that today’s educational institutions mainly revolve around the factors that are given in the table 1.

FUNCTIONAL AREA	BUSINESS CHALLENGE	OPPORTUNITY
Student and Faculty Acquisition	Acquire the most talented students who will also have a successful academic career Attract and acquire most reputed and talented faculty members	Increase share of top students recruited Increase graduation rate
Student Course Major Selection	Assure that students select majors that will lead to academic and post graduate success	Align student passion to course of study Improve graduation rate Improve alumni job prospects / placement
Student Performance	Maximize student performance so that academic and personal goals will be achieved	Understand academic problems early and take corrective action Encourage better habits and techniques to improve performance
Student Retention	Retain gifted students throughout their academic career	Understand student dissatisfaction early and take corrective action Improve institution sentiment in the broader community
Teaching Effectiveness	Understand and promote most effective instructors	Improve student academic experience and outcome Reward the most impactful instructors Share best practices across the institution Take corrective action where instruction is least effective
Research Optimization	Shorten time consuming research and produce accurate and impactful outcomes	Analyze enormous experimental data sets in near real-time using predictive models Eliminate errors through automated data acquisition Differentiate research capabilities versus other institutions
Student Progression	Identify at risk students and help them get back on track towards graduation.	Analyze at risk students and the cause of the issues Improve graduation rates

Table 1: Higher Educational functional area, business challenges and Opportunities

The framework that provides the solution information retrieval and academic activities using big data analytics is depicted the figure 3.

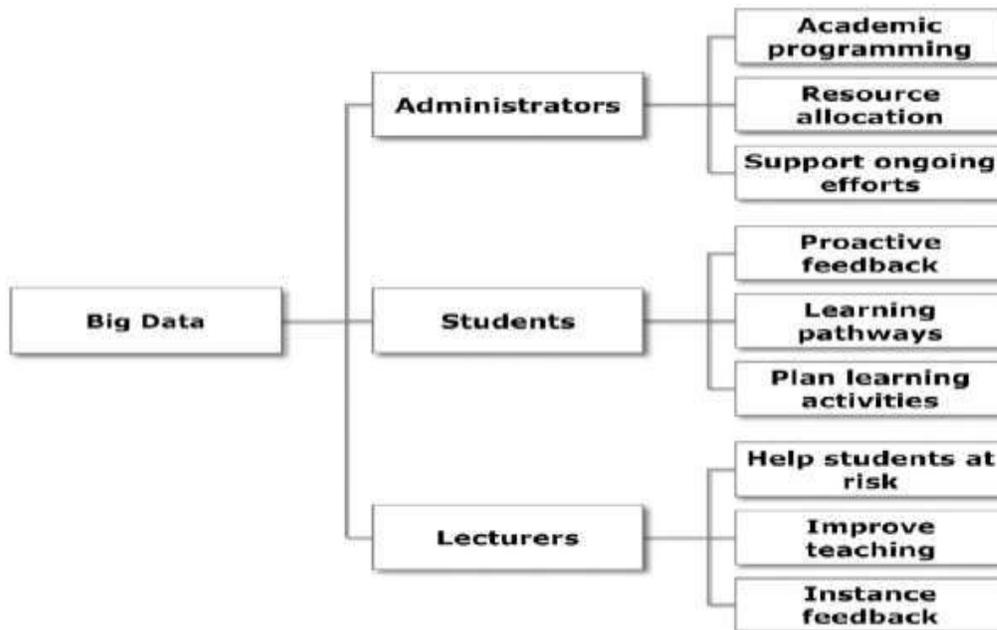


Figure 3: Key Big Data Framework to explore opportunities for three end users

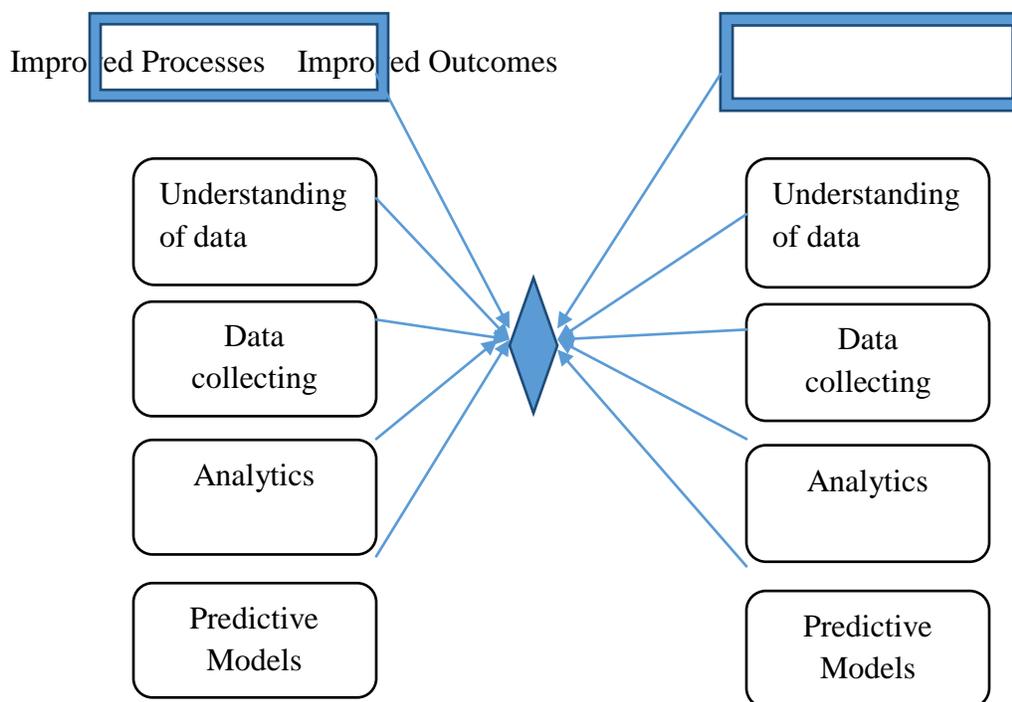


Figure 4: Big data Analytics outcomes

With large volumes of student information, including enrolment, academic and disciplinary records, institutions of higher education have the data sets needed to benefit from a targeted analytics. Big Data and analytics in higher education can be transformative, altering the existing processes of administration, teaching, learning, academic work (Baer&Campbell, 2011), contributing to policy and practice outcomes and helping address contemporary challenges facing higher education.

Big Data can provide institutions of higher education the predictive tools they need to improve learning outcomes for individual students as well ways ensuring academic programmes are of high-quality standards. By designing programmes that collect data at every step of the students learning processes, universities can address student needs with customised modules, assignments, feedback and learning trees in the curriculum that will promote better and richer learning.

One of the ways higher education can utilise Big Data tools is to analyse the performance and skill level of individual students and create a personalised learning experiences that meet their specific learning pathways. When used effectively, Big Data can help institutions enhance learning experience and improving student performance across the board, reduce dropout rates and increase graduation numbers. The key contribution of Big Data will depend on the application of three data models (descriptive, relational and predictive) and the utility of each to guide better decision making (Figure 5).

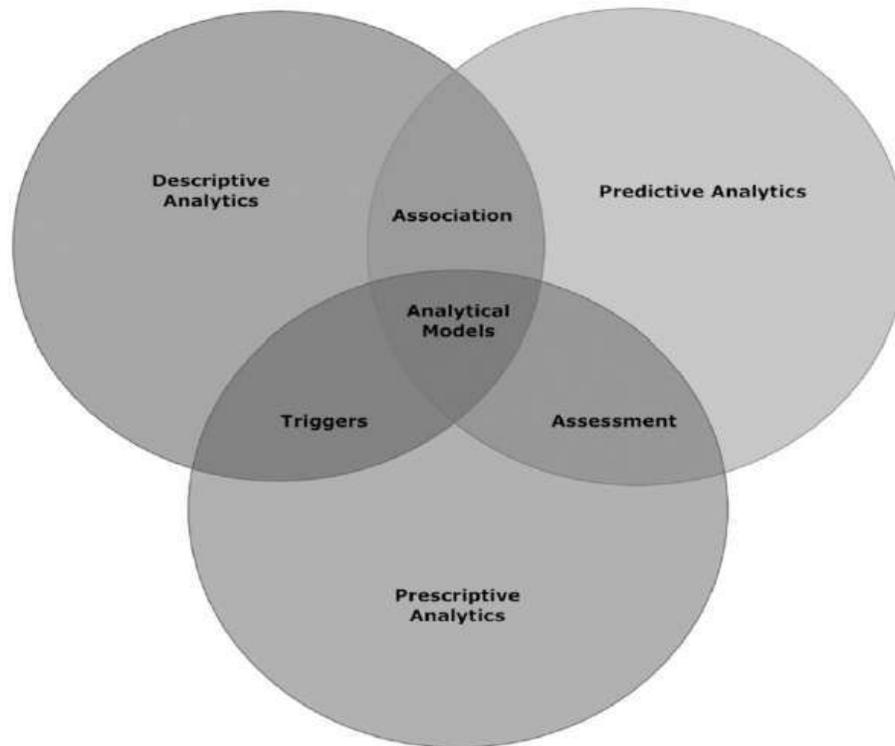


Figure 5: Three Big Analytical Model in Educational Institutions

Descriptive analytics targets at unfolding and analysing historical data collected on students, teaching, research, policies and other administrative processes. The area is to identify patterns from samples to report on current trends—such as student enrolment, graduation rates and progressions into higher degrees.

Descriptive analytics also delivers institutions of higher education with an opening to analyse transactional and interactional data about teaching learning and research to recognize apparent trends and patterns that are likely to trigger important dialogue on current and future issues. Specifically, with descriptive analytics, institutions can inspect data within learning management systems by looking into the frequency of logins, page views, and course completion rates for a particular programme over time, students attributes of those who completed versus those struggling, which content is being visited many times, etc.

Predictive analytics can deliver institutions with healthier decisions and unlawful insights based on data. Predictive analytics aims at approximating likelihood of future events by looking into trends and identifying associations about related issues and identifying any risks or opportunities

in the future. Predictive analytics could reveal concealed relationships in data that might not be deceptive with descriptive models, such as demographics and completion rates. It can also be used help to look at students who are exhibiting risk behaviours early in the semester that might result to dropping out or failing a course. It can help teachers look at predicted course completion rate for a particular and tools and content in the course are directly correlated to student success. Prescriptive analytics aids institutions of higher education measure their current situation and make knowledgeable choices on substitute course of events based on valid and consistent predictions. It combines analytical outcomes from both descriptive and predictive models to look at assessing and determining new ways to operate to achieve desirable outcomes while balancing constraints.(Basu, 2013) indicated that prescriptive analytics enables decision makers to look into the future of their mission critical processes and see the opportunities (and issues) as well as presents the best course of action to take advantage of that foresight in a timely manner. In summary, Big Data Analytics provides institutions of higher education to leverage existing data and collect missing data to help make better decisions, with various outcomes.

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