

# DRIVING BIG DATA INTO THE E-LEARNING SYSTEM: THE CHALLENGES

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## Abstract

Big Data has always been at the forefront in this world full of digital transformation, especially when the educational sector has become a highly competitive and dynamic environment. However, the COVID-19 pandemic has accelerated the use of Big Data in every single aspect of the economy, society and education. Online learning, also known as e-learning is one of the efforts of implementing Big Data in the education system. This article will be discussing on the challenges of implementing Big Data in the e-learning system, which touches on the demands of Big Data, algorithmic bias, traditional paperwork culture and cost management.

**Keywords:** *Big Data, e-learning, learning management system, information system, algorithmic bias, cost management, learning technology*

## Introduction

In a world full of digital transformation, in which new information and communication technologies are constantly evolving, Big Data has become an essential aspect of innovation which has recently gained major attention from both academics and practitioners. The education sector is a highly competitive and very dynamic environment; it is only natural for educational organizations to keep up with this phenomenon, e-learning being one of them. However, such innovations are not without its challenges, especially when focusing on incorporating Big Data in education via e-learning. There are a number of concerns when it comes to the

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usage of Big Data in e-learning: the high demand of Big Data, algorithmic bias, willingness to practice e-learning and cost management.

## **Big Data Convergence with E-Learning**

### *Big Data*

The term “Big Data” refers to a group of large data sets rich with information that is ready for users to analyze and extract. There is no singular definition of Big Data due to its unclear interpretation. However Big Data may be regarded as the three V’s which are: volume, velocity and/or variety that constitute information assets that necessitates cost-effective, innovative forms of information processing for increased understanding, decision-making, and process optimization.<sup>i</sup>

David Kellogg had simplified the definition of Big Data as data that is too big to be reasonably handled by current traditional technologies.<sup>ii</sup> This is actually in line with Organization for Economic Cooperation and Development (OECD) remarks about Big Data, which they stated that the definition of Big Data will continuously change, as it depends on the evolving performance of technologies.

### *Learning Management System*

Realizing that there is an ever-growing use of Big Data in many industries, education institutions started to incorporate Big Data to improve online learning or e-learning, by setting up a Learning Management System (LMS), a web-based software application used to deliver knowledge online.<sup>iii</sup> LMS is managed by an Information System (IS) which is a group of computer tools that is used for collecting, storing or processing data.<sup>iv</sup>

The use of Big Data in e-learning is called learning analytics, in which a variety of ISs collect the data throughout the whole learning process.<sup>v</sup> Now, the use of an IS in e-learning is crucial as it effectively collects data and its responsiveness allows academic experts to not only create, but also to deliver their knowledge digitally. As it collects a vast amount of data, it is not only confined to delivering lessons, but

an IS also manages the content of the website software and also observe and assess students' performance.<sup>vi</sup>

With the help of an IS, the data from interacting with the e-learning course will be sorted, filtered and correlated to a certain metric which can show patterns as to the student's performance in their interaction with the online course. As an example, the collection of data will show a specific set of behaviors that acts as an early warning sign that a student will struggle or fail in that course based on their interaction with the e-learning course, hence the teacher or instructor will be alerted in order to reach out to the student and intervene. If the problem affects the majority of students, the teacher or instructor and course designer can and will make adjustments to the online course that can help the struggling students to be more successful in their online lessons.<sup>vii</sup>

### *E-learning*

The concept of e-learning was first mentioned in 1990 and had no standard definition.<sup>viii</sup> However, Heru Susanto, Fang-Yie Leu and Chin Kang Chen in "The Emerging Technology of Big Data: Its Impact as a Tool for ICT Development" had mentioned that the concept of e-learning dates far back to the 1980s, but it was never made known to the public, hence there are no accurate records regarding this. Therefore, this further proves that there is not exact definition for the term 'e-learning'.

In general, e-learning ranges from email exchanges between students and teachers to a whole learning class which can be done online or web-based.<sup>ix</sup> E-learning also complements the traditional learning experience; allowing teachers or instructors to have the ability to teach physical classes yet they can also incorporate the use of technology for a more engaging learning experience, such as online lesson activities, simulations, virtual laboratories and even online tests.<sup>x</sup>

## Challenges

There are quite a few challenges of incorporating Big Data in e-learning systems that must be made aware by education institutions. As stated previously, Big Data is a group of large data sets that is rich with information to be analyzed and extracted by users. In addition to that, due to the evolving performance of technologies, Big Data's definition will eventually change, hence technologies must be up-to-date to these changes lest more problems will arise.

### i. High Demand of Big Data

With the ever-growing definition and concept of Big Data, it is still quite a challenge for leaders and organizations to meet the high demands of Big Data due to lack of degree of coordination and control.<sup>xi</sup> This also brings the active need for big educational data processing to have decisions based on analysis and not only intuition or experience, which is quite an obstacle for a more widespread use of e-learning. For a clearer picture into this, this can be seen from the use of Learning Information System (LMS), which is usually used for conducting online courses and other aspects of learning in the academic field.<sup>xii</sup> It is to be noted that LMS tends to be more of course-centered rather than student centered as it does not support various teaching styles as it is not intended to train or develop, but to manage. This leads to it being no guarantee that learning can be improved due to the single teaching style that the LMS brings.<sup>xiii</sup> With this situation in mind, it is quite difficult to make adjustments since creating a LMS that can hold more than one teaching style requires a huge amount of data to extract, process and analyze which can cause errors and the quality of data will deteriorate due to the inaccurate analysis of data.

### ii. Algorithmic Bias

An issue that is a cause of concern in e-learning would be algorithmic bias.<sup>xiv</sup> As mentioned earlier, the use of IS is to process, analyze and extract data in which it sets an algorithm for a more efficient e-learning environment. However, since IS relies heavily on data, this means that their performance is solely by data. It is also

to be noted that algorithms will adapt to the qualitative and quantitative characteristics of data.

This actually means that the algorithm will detect the data that is more prominent, say, data from students from the general population in which the data may contain better information as compared to data from students that are of the minority. Hence, the algorithm will produce a system along with the recorded errors – in an attempt to improve the learning experience – which is more advantageous to the students of the general population and disadvantaging the minorities.

When there is a lack of applicable standard measures and indicators to represent educational variables such as educational progress estimation, this algorithm bias will only further increase the disparity between the students of the general population and students of the minority.<sup>xv</sup> In addition to that, there are students that may have similar behavior patterns but this does not conclude that there is a similarity between learning styles and preferences,<sup>xvi</sup> hence there may also be some disparities within these two categories of students, too.

### iii. Academic Staff Willingness

With the recent COVID-19 pandemic and the growth of more digitally-driven knowledge economies, traditional formal education systems are undergoing drastic changes or even a paradigm shift.<sup>xvii</sup> Therefore, more solutions and plans to integrate emerging technologies into students' learning are quite ready for adoption.

However, the increasing use of Big Data and e-learning in education does not only affect the learners, but it also affects the teachers, too. There is an apparent divergence between a large number of pre-service and in-service teachers and their willingness to support and adopt these emerging technologies.<sup>xviii</sup>

Pre-service teachers are more willing to adopt modern technologies due to greater exposure to them while in-service teachers are more reliant on their practical experience in their teaching.<sup>xix</sup>

Aside from that, a research survey was conducted by Rita Marcella and Karl Knox for their paper titled “Systems For The Management Of Information In A University Context: An Investigation Of User Need”, in which the survey found that over 60% of university staff from the universities under their study reported that they faced problems with the current computer interfaces and/or systems.<sup>xx</sup>

In addition to this, there is the issue of teachers with weak computer and information literacy skills; which makes it difficult for them to use the LMS as it’s those exact skills that are required to effectively use LMS to aid their teaching in e-learning.<sup>xxi</sup> In response to this, many teachers also faced difficulties in designing and organizing learning activities that are appropriate with the students’ needs and the teacher’s teaching styles to create a better e-learning experience.<sup>xxii</sup>

#### iv. Cost Management

The next concern that education institutes must consider in implementing e-learning into their courses would be the cost, which can be very high if financial planning is not done carefully.

It may not be a problem if the implementation of a new learning technology is just on a departmental level as the cost can be funded by a grant for the whole department’s use.<sup>xxiii</sup> However, when it comes to implementing to the university’s system as a whole, there needs to be the involvement of the state or there is a budget provided to bear the cost of the new learning technology.<sup>xxiv</sup>

This is due to the fact that for a proper and massive scale of implementation of a new learning technology for the whole organization, it is required to build state-of-the-art facilities for the latest technology.<sup>xxv</sup> This also includes building/preparing facilities such as a computer laboratory for the use of students since there are bound to be a group of students that do not have access or cannot afford a personal computer with the latest technology and software that can aid them in their lessons, assignments and access to e-learning modules.<sup>xxvi</sup> If such facilities are not prepared, this will hinder the student’s performance in their studies which, in turn,

will cause difficulties to the teachers that will be using the new learning technology to assess their students' performance.

Aside from that, the university academic staff must also be given training in innovative data management skills in order to efficiently utilize the new learning technology.<sup>xxvii</sup> Universities and education institutions must bear in mind that their academic staff and lecturers are not necessarily residing nearby the university's vicinity, hence a seminar must be arranged in order to train every university staff. This seminar can be arranged via online, however there can be a few difficulties such as the Internet connectivity and the limit of participants in one online seminar, as certain video conference software only allow a certain number of people in one video conference. The issue of Internet connectivity can be resolved by increasing the network speed, but for a huge amount of people's usage, the cost that the university must bear will be quite high.

There is also the question of calling in an expert to train the university staff. Although it is possible for the university's own IT department to train the other departments in using the learning technology, an expert must at least be called in to guide the IT department especially when it comes to newer and more recent learning technology. This training may also not necessarily last for a day or two days of training, sometimes a follow up training must also be arranged in order for a smoother transition of the learning technology in the e-learning course. The cost of the expert and follow up training may cost some big expenses to the university especially when it comes to implementing current technology, in which not many have knowledge of.

Moreover, the upfront cost of acquiring a Big Data management system makes up only a small portion of the cost of Big Data. The big question here is the cost of managing and maintaining the Big Data infrastructure, which is a set of physical technologies that consists of storage warehouses, servers, network and monitoring tools. Keeping in mind that implementing Big Data management system into the e-learning system means that more Big Data infrastructures are needed due to the fact that the whole of the university or learning institution which includes staff and

students will be using it. Therefore, more people are needed to manage and maintain the Big Data infrastructure.

Moreover, as Big Data is an ever-evolving technology, eventually the whole Big Data infrastructure must be changed or updated from time to time so that it will not end up being outdated, which will cause troubles to not only the users such as the staff and students, but also to the people managing the infrastructure. This, of course, costs a lot of money, too, especially when it is for the use of a whole organization or institution.

## **Conclusion**

The ever-evolving Big Data has become an essential part of the educational sector, especially when it comes to e-learning. However, there are certain drawbacks that the leaders of the educational sector must keep in mind when implementing Big Data in e-learning. The main drawback is that Big Data in e-learning relies on technology and data which sets aside the social elements that are important in education. Education should not neglect the students' development and needs as a whole, in fact it needs to strive to create an environment for the students to feel that they are all of equal standing, rather than feeling that they are disadvantaged due to their social standing. In addition to this, teachers or instructors face the struggle of this implementation due to it being different from the traditional approach and the costs of implementing and maintaining the Big Data infrastructure must also be considered for the use of Big Data in e-learning in the long run.



## Endnotes

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