

How to Cite:

Rivera, H. V. H., Aponte, M. B. H., Gonzales, J. L. A., Chávez, M. del R. C., Cahua, K. D. M. I., & Carranza, C. P. M. (2022). How big data is used as a key element for hybrid university education. *International Journal of Health Sciences*, 6(S1), 834-844.
<https://doi.org/10.53730/ijhs.v6nS1.4841>

How Big Data is used as a Key Element for Hybrid University Education

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Abstract--Hybrid learning in universities is the blending and mixing of the learning environments, this includes both face-to-face (FTF) which implies classroom instruction and online environment (E-learning) as well. According to De Mauro, Greco and Grimaldi (2016), Ellis' study shows that hybrid learning provides the students with the opportunity to understand and explore the real world at the same time through various authentic experiences. Authentic experience as cited by De Mauro, Greco and Grimaldi (2016) can be facilitated in the online learning environment through coming up with sufficient online learning or by blending learning to combine both online and FTF learning. The main objective of hybrid learning is to enhance effective and efficient experience through a more improved delivery model. This study is based on the review of previous articles using PRISMA methodology, it focuses on the big data as key element in hybrid learning in university education. The main objective of this study is to review 40 articles published in Scopus within 2010 to 2022 subject to big data in education, hybrid learning in universities or higher

learning institutions and based on their findings the study come up with a conclusion as discussed below.

Keywords--*Hybrid learning, University education, face-to-face and online learning, PRISMA.*

Introduction

Almost all institutions are collecting ever-expanding amounts of data that are referred to as big data. To get the most out of this data, scientists and engineers apply quantitative and qualitative methodologies to collect, analyze, and structure this information which can be used by these organizations to provide insights to foresee trends, learn about people's habits, and create better solutions. According to Wang et al. (2016), big data in education can assist universities and colleges improve their economic models, students' academic outcomes, and professors' performance. Using information gleaned from massive amounts of data, educational institutions can enhance their technology infrastructures. To transform education, data science and analytics professionals are essential. Students who want to help schools and institutions better comprehend the importance of data and analytics may benefit from an online bachelor's degree in computer science.

Different technological systems are used by universities to manage different areas of the organization. It is possible to integrate essential systems, applications, and platforms with big data. In turn, this enables them to minimize expenses and create efficiencies. Big data is changing the way schools look at information and make decisions about things like academic success, faculty effectiveness, outreach efforts and technology efficiency (Bag et al., 2021). Students' performance is evaluated by their professors based on statistics. Increased participation may be revealed in the data. Additionally, teams of professors can, for example, use data on attrition, total course enrolment, and student performance to inform their work on improving course content. With the use of big data analysis, professors may improve the learning environments they build and the assessments they administer (De Mauro et al., 2016). Students' incorrect responses on tests and the time it takes them to complete a task can be tracked using analytics software. Teachers can use this information to tailor their lessons to students' needs and students' precise feedback can be used to ensure that future semesters will produce the best results possible.

Students from varied backgrounds, national and global economic, social and political shifts, technology advancements as well as increased Internet use are all factors that contribute to a competitive climate for many schools (Gramage, 2016). Many educational institutions throughout the world are struggling to keep up with the demands of blended and online learning as well as traditional classroom instruction. In many universities, the use of information and communication technology (ICT), especially online learning resources (OLR), has become the norm (De Mauro et al., 2016). The research by Hashem et al. (2016), shows that online resources include a wide range of content, including texts, films, photos, journals, case studies, databases, and curriculums, that may be

accessed over the Internet. By having a thorough understanding of the learning process of students to create learning methods, and by enabling personal learning activities, learning analytics may enhance learning and teaching practices (Iqbal et al., 2020). Using big data and data mining techniques, students, faculty, administrators, and developers/researchers in higher education may take advantage of the successes of their fellow students, faculty, and institutions.

More so, departments at higher education institutions must prepare students in a wider sense for the industry they will be working in despite technology advancements in online or face-to-face learning settings. Recent years have seen a fast rise in the use of big data analytics and related toolsets (Kibria et al., 2018). Despite this, it is often discovered that the official curriculum does not meet the needs of today's technology, tools, and applications. Therefore, this study is done to determine how big data can be used as a key element for hybrid university education. Using PRISMA methodology, the study researched articles on big data analytics in higher education which were analyzed in this study to identify the subject matter of big data analytics in higher education and to investigate curriculum advancements.

Big data in education

As previously stated, a variety of data analysis tools are used by businesses to make operational and strategic decisions. Because of the shift like the data accessible within businesses, the way it is kept and processed has also changed. Managing unstructured and complicated data is a difficult task in today's world. Traditional database systems cannot keep up with the rapid growth of new forms of data, which come from a variety of sources. Database systems have changed dramatically as a result of the ever-increasing volume of data that is now available to businesses. Analyzing large amounts of unstructured data, known as big data which are used by different institutions to come up with analysis, data visualizations that are used to yield interesting patterns and insights. A content management system is needed to keep track of students, courses, grades, certifications, institutions, and learning providers. Educational environments feature a wide spectrum of users, each of whom brings a unique viewpoint to the table in terms of their goals, vision, and mission (Lv et al., 2019).

Students, instructors, course creators, organizations/learning providers, and administrators make up the first four of Romero & Ventura's (2010), as cited by Miloslavskaya & Tolstoy (2016), recommended user groups for educational settings. There are two sorts of analytics: (1) learning analytics, which include course-level and department-level; and (2) academic analytics, which cover institutional, regional, national, and worldwide levels. Students, faculty, administrators, and course designers in higher education may all benefit from big data analytics. In their study, they stated that universities can benefit from big data in various ways which can be summarized as shown in figure 1 below.

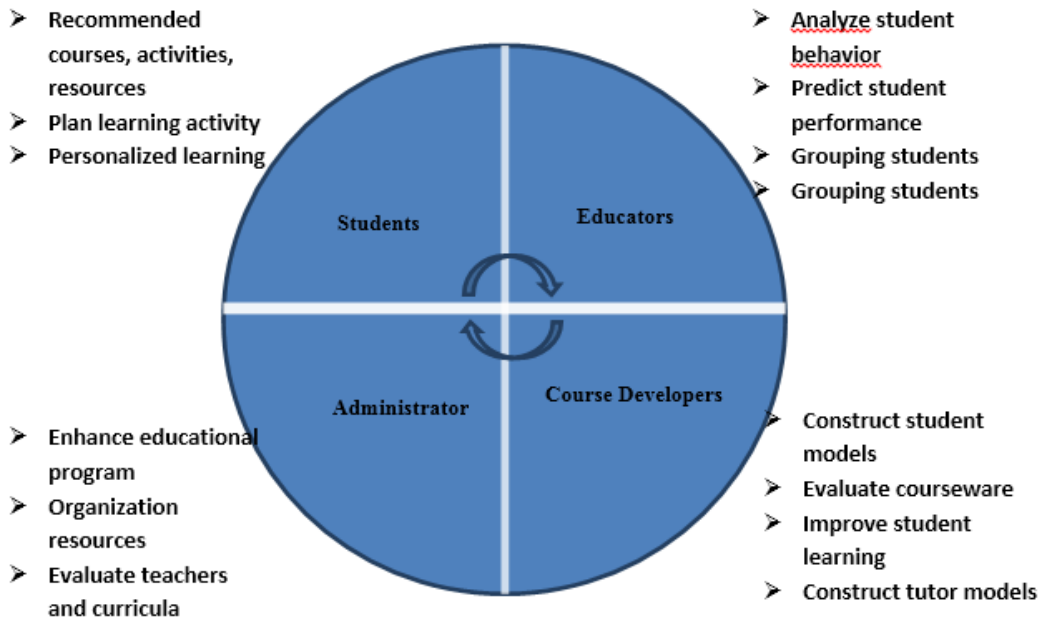


Figure 1. Big data four scope users in higher education (source: Romero & Ventura, 2010)

Daniel & Butson (2013), on the other hand, aimed in their study to find a proper guideline of big data within universities and thus came up with the model as shown in figure 2 below.

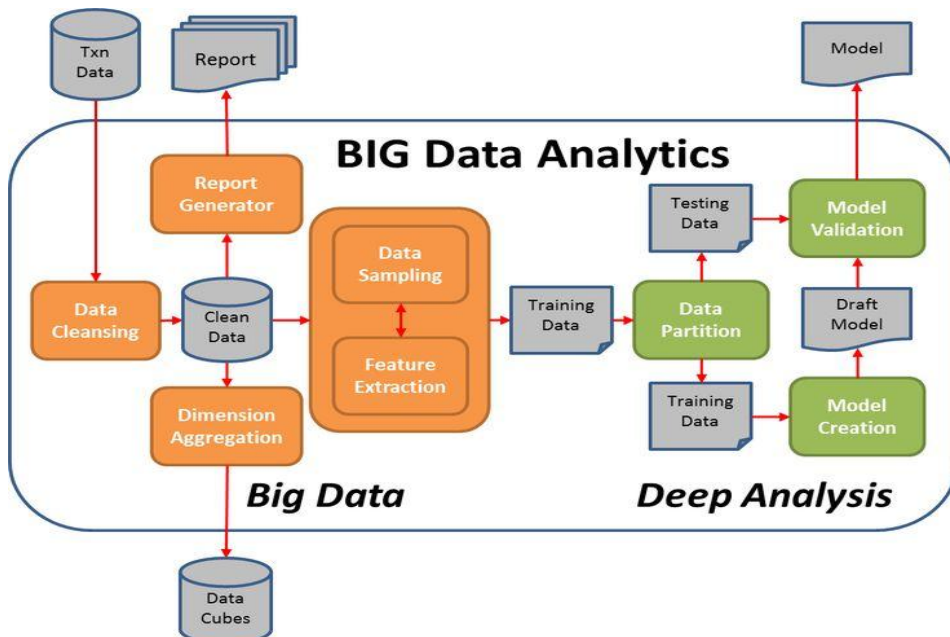


Figure 2. Conceptual model of educational big data (Source: Daniel & Butson, 2013)

According to [Daniel & Butson \(2013\)](#), the end-users in the data aggregation framework above are the students, instructors, researchers and policymakers. The above framework according to them consists of four main components; academic analytics which includes information regarding programs and students' performance challenges, learning analytics which involves collecting, measuring, analyzing and reporting the findings from the data regarding students and their circumstances in the institution. In learning analytics, the main intention is to understand and help in improving the learning outcomes of students and the regions from which it results ([Mohammadi et al., 2018](#)), institutional analytics on the other hand analyses the operational data that is used to support the effective decision in the institution this can be done through assessment policies analytics, structural and instructional analytics and finally information technology analytics which uses performance data that are used in form of examination of technology, progress data standards, progressing, policies, organizations' synergies and technological tools.

The concept of hybrid learning

Hybrid Learning combines an online learning environment with face-to-face (F2F) classroom instruction to create a more flexible learning experience ([Pencheva et al., 2020](#)). A key benefit of hybrid learning is that it allows students to interact in person with their teachers and fellow students to ask questions and engage in debate. In courses delivered entirely online, these tangible encounters are missing. In hybrid learning, the advantages of both online and in-person instruction are combined. Teachers serve as both facilitators and instructors, offering assistance to students as needed and delivering lessons that complement the students' online courses. It has been characterized as a "diverse and increasing field of design and investigation that incorporates face-to-face as well as online modes" ([Mohammadi et al., \(2018\)](#)).

Four characteristics describe hybrid learning, according to [Romero & Vantura \(2010\)](#): (1) a combination of self-paced and group-paced learning; (2) the use of formal and non-formal learning; and (3) the incorporation of lifelong learning into and/or in the learning environment. Because of this combination of the collective intelligence of multi-agent systems in a collaborative context and the methods used to process and deliver instructions, [Viloria et al. \(2018\)](#), characterize hybrid learning as a blend of collective and individual learning. On the one hand, there are synchronous approaches such as those used in an online classroom where students can be taught individually or in groups, and on the other hand, there are asynchronous approaches such as those used in an excellent platform for distance learning techniques and which can be taught in a wide range of ways ([Salminen et al., 2017](#)). Encouraging a more in-depth, meaningful dialogue with students from diverse historical periods, continuing ongoing talks where archives are required, and allowing all students to participate in a topic ([Salminen et al., 2017](#)). Self-paced internet learning with rich media resources and real-time or in-person group collaboration are two approaches to hybrid learning that [Sedkaoui & Khelfaoui \(2018\)](#), present through an asynchronous online conversation as an example of practicality. As a result of smart systems and smart agents (such as web interfaces) capable of understanding the unique challenges and variances of learners, hybrid learning has transformed education. When it comes to teaching

and learning, Wang et al. (2016), say that teachers become coordinators of knowledge sources that can handle and process the pace of learning, while students are expected to participate actively in the learning process as well as develop an individual learning area and use multiple or two-way basing in place of attendance and examination requirements. Teachers. When compared to the traditional "start-to-finish" education model of education, hybrid learning offers the concept of lifelong learning, which may be pursued at any moment in a person's life, given that courses are taken through a learning system in the last few years, a new form of distant education known as Massive Open Online Courses (MOOCs). It's entirely up to the individual to pursue whatever interests them at this time.

Method

In the systematic literature reviews, as used in the study, the articles used in this study were conducted on the subject of big data as a key element of hybrid learning in university education and relevant articles were selected for the PRISMA analysis. The selection criteria used in this study include:

- The article has to be published in English;
- The articles selected must be published between 2010 to 2022;
- The article selected has to have used the Scopus database for the research;
- The articles must be related to big data in university education and hybrid learning.

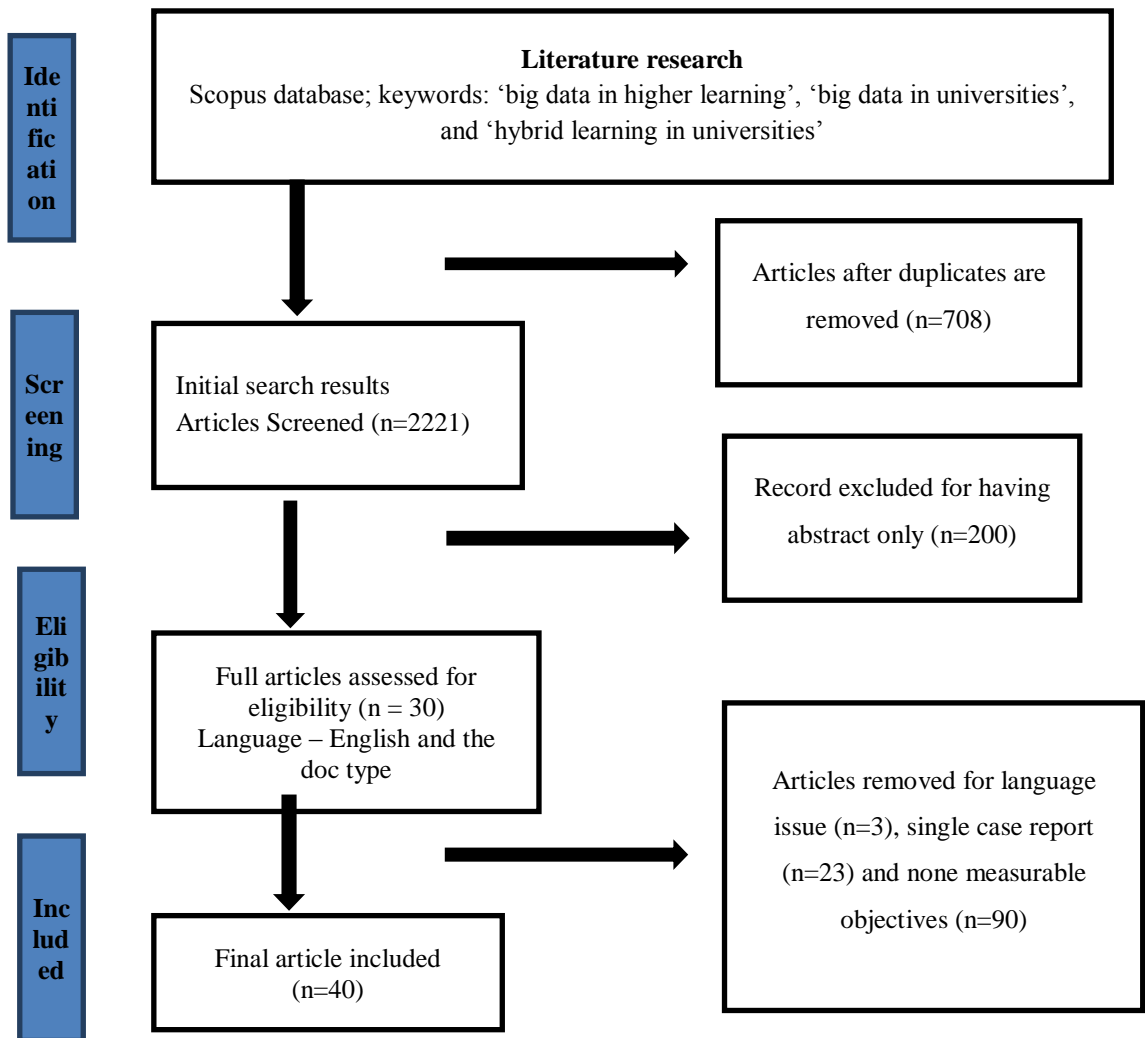


Figure 3: PRISMA Article Selection process

Findings

Figure 3 above depicts the article selection process, showing the number of articles included in each stage based on the criteria. A total of 250 articles were found after the articles containing the keywords "big data", 'hybrid learning' and "higher education" and those that were in the final stages of publishing were selected. The complete text of 81 of these articles was then culled through a screening process. The titles, abstracts, and keywords of these papers were then analyzed. The study did not include any papers on big data analytics in any other field outside higher education. Other approaches to higher education beyond big data analytics were not included in the discussion. Finally, there were 40 papers in this review.

Open universities in the United Kingdom and the United States are already using e-learning, but hybrid learning is still a relatively new phenomenon in higher

education (Wang et al., 2016). Constructivism or active learning, resource-based learning, collaboration, problem-based learning and narrative-based teaching can all be employed in an e-learning course. According to Xu, Frankwick and Ramirez (2016), the formal environment of higher education uses a lot of these teaching strategies. E-learning hybrid learning program implementation is still heavily reliant on the intended audience, course content, and well-defined learning goals. In a hybrid learning approach, geography, time, and delivery mode are all intertwined. They are made by organizations. Students may be able to customize their learning modules depending on the course and style of education (degree or non-degree). Research on teaching and learning analytics, hybrid education, as well as big data issues and prospects were all examined in this study. Articles on educational policy, assessment, evaluation and adoption, as well as curriculum creation and ethics and privacy, were also included (Williamson, 2017). There was a total of 12 articles about learning and teaching analytics that were evaluated. Methodologies such as literature review or framework creation and model design were found to be the most commonly employed in these papers. Case study and topic analysis were also included as the articles' research methods. Six articles were devoted to the topic of distant education. In the papers, online learning and distance learning were both used interchangeably to describe distance learning (Williamson, 2017). Some of the techniques employed in publications about distant education included case studies as well as literature reviews, model design and framework creation, clustering algorithms and chaotic optimization. Challenges and possibilities were the third most often reported aspect of big data in higher education. This is rare, but it does happen. According to Xu et al. (2016), the method of creating hybrid education programs is nearly the same, but various elements such as culture, course type and student characteristics may vary the components of this approach.

Discussion

This evaluation included a total of four papers about curriculum creation. One of them developed a new approach for teaching Business Information Systems to undergraduates, graduate students, and business professionals at all levels. Faculty, students, and industry experts came together in Iqbal et al. (2020), to use Krathwohl's updated taxonomy to add relevant optional courses to the current curriculum. They conducted interviews, surveys, focus groups, and literature studies as part of a multi-methodological approach. Two aspects, knowledge and cognitive process, are used by Krathwol to define learning outcomes in a program. Using the BI themes in undergraduate, master's, and MBA programs as a guide, they assessed Krathwohl's two dimensions. The BI model curriculum was divided into three tiers, each with a set of BI themes. It has been proposed that non-technical students should have access to courses in cloud computing, big data analytics, social media, mobile programming, and cyber security as part of the curriculum proposed by Kibria et al. (2018), 61 professionals, including academics, students, companies, and technical personnel, were part in the European Union-funded study. Two partner institutions revised their undergraduate and graduate programs as a result of the pilot test. Non-technical students in the fields of business, finance, economics, statistics, and marketing gave positive comments and indicated an interest in the

new curriculum, according to the researchers. These subjects might be added to the undergraduate and graduate curriculum of universities.

An examination of the content and key topics covered by Big Data syllabi at various US academic institutions was carried out by [Mohammadi et al. \(2018\)](#) in this study. We found 35 course outlines from various academic institutions, the majority of which were in the area of Information Technology (such as computer science or engineering). Courses on big data were also offered in the Business field. In terms of percentages, the eight most popular themes were: Data-Driven Application Systems (% 49), Hadoop MapReduce and Spark, R and Python, Data Mining Models (percentage 41), Data Sources, Machine Learning, Statistical Analytics, Predictive Analytics, and Visualization. After conducting the investigation, it was discovered that textbooks, resources, and key concepts of big data were lacking in standardization. A framework for creating a data analytics curriculum based on data-driven analysis was created by [Hashem et al. \(2016\)](#). Analyzing a curriculum's teaching, learning, and evaluation from a data analytics approach was recommended in the study. Big data analytics curriculum development has primarily targeted non-technical students in higher education, particularly business students. Big data analytics will be needed across a wide range of industries. Big data analytics should be incorporated into university courses in order to identify analytical talents and capabilities that meet industrial standards.

Conclusion

Students, teachers, and other specialists or institutions can collaborate in the learning process through the use of Hybrid Learning. As outlined by the four components, the important aspect of hybrid learning is that it can be tailored to the requirements of the student and the specifics of the course. Individuals who have limited time and space may benefit from hybrid learning, which provides a wide range of options ([Bag et al., 2021](#)). Cross-disciplinary collaboration, institutional bridging, and non-formal learning environments have all found hybrid learning to be productive and useful. Due to limitations in terms of application, integration, social consequences on learners, and cost limits, hybrid learning has been less widely adopted by providers. In higher education, big data analytics play a significant role. An overview of big data and its features is provided in this research. Students, instructors, administrators, and course creators all benefited from the use of big data technologies, which were presented in detail. Pupils, teachers, curriculum, and courseware are all benefiting from the four stakeholders' use of learning activities and recommendations, as well as grouping and modelling students ([Daniel & Butson, 2013](#)). Furthermore, the conceptual paradigm of educational big data analytics was evaluated and addressed. Another focus of this research was on the role those big data technologies play in improving educational analytics and student achievement. Traditional classrooms, online, mobile, blended, digital game-based learning, and gesture-based learning were all briefly referenced in a framework, as were other forms of education.

In the last ten years, big data analytics and related technologies have grown in popularity and sophistication. Formal education, on the other hand, does not

match the needs of the business. Big data analytics in higher education was studied by methodically reviewing 40 pieces of literature on the subject. Big data analytics in higher education has mostly been found in the fields of learning and teaching, according to the study's conclusions. Most of these studies employed a combination of literature review and framework creation techniques. For online learning and big data in higher education problems and possibilities, the second and third most popular articles were published. It should also be emphasized that there were few published studies on curriculum design. Big data analytics curriculum development has mostly targeted non-technical students in higher education, according to the findings of the literature study. However, it has been concluded that big data analytics and information systems are required to varying degrees.

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