RISING VALUE OF DATA IN CONTEMPORARY HIGHER EDUCATION

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ABSTRACT

Purpose - The purpose of this study is to reflect the importance of effective use of data to predict and improve academic success as an essential criterion for assessing the quality of higher education institutions in the 21st Century. This paper intends to clarify importance of data and its evaluation components, namely Educational Data Mining (EDM), Learning Analytics (LA), Artificial intelligence (AI) and Machine Learning (ML), as integral part of Fifth Generation Universities (UNIVERSITY 5.0) era in the globalized competitive higher education sector. For this reason, this paper advocates "Rising Value of Data in Contemporary Higher Education" for the university of the new age.

Methodology - The study employs a literature review aiming to reflect the new atmosphere and requirements in the higher education system based on selected topics. A comprehensive analysis on the game changer role of data in the higher education institutions was considered. The aim was to identify the difference created by effective use of data in higher education institutions to predict and improve academic success in the competitive academic environment of the new era.

Findings - The analysis reveals that higher education institutions should understand the essential role of educational data with the expansion of digital revolution and rapid change in technologies in the 21st Century and design their strategies accordingly. Notably, it is clearly seen that the universities have not only effectively use educational data and its evaluation components namely Educational Data Mining (EDM), Learning Analytics (LA), Artificial intelligence (AI) and Machine Learning (ML) but also internalize the reality of their rising value to predict and improve academic success as well as creating a significant financial contribution to their development. As a matter of the fact, universities established many projects and effectively used their Learning Analytics (LA) tools. Besides, the emergence of Artificial intelligence (AI) and Machine Learning (ML) enhanced the efficiency and effectiveness of management operations.

Conclusion - Findings may be concluded that universities need to apply the effective use of data particularly in the context of new era like Industry 5.0, Society 5.0 and University 5.0 to obtain academic success, which is considered as an essential criterion for assessing the quality of higher education institutions. Indeed, universities have to follow a data- driven culture as greater demands of universities already appeared for retention, completion and graduation rates of students to improve student success. As a matter of fact, the effective use of Educational Data Mining (EDM) and Learning Analytics (LA) is going on for the last two decades in higher education institutions. Indeed, Artificial intelligence (AI) and Machine Learning (ML) are effective in data management as two impressive game changers for universities changing educational world from the financial perspective. For this reason, it may be argued that the effective use of data and its evaluation components, namely Educational Data Mining (EDM), Learning Analytics (LA), Artificial intelligence (AI) and Machine Learning (ML) are considered as the integral part of Fifth Generation Universities (UNIVERSITY 5.0) era in the globalized competitive higher education sector of 21st Century.

Keywords: Higher education, educational data mining, learning analytics, artificial intelligence and machine learning, University 5.0
JEL Codes: A20, I23, M10, O31, O32

1. INTRODUCTION

Academic Success is considered as an essential criterion for assessing the quality of higher education institutions (Alyahyan and Düştegör, 2020) in the 21st Century. It is defined as concentrating on the most important six components as academic achievement, satisfaction, acquisition of skills and competencies, persistence, attainment of learning objectives, and career success (York et al., 2015).

For this reason, understanding new environment in higher education is critical, especially from the side of effective use of data in the era of digital transformation. Increase in educational data happened at a swift pace with the expansion of digital revolution and rapid change in technologies. Learning analytics (LA) appeared as a powerful tool for improving learning and teaching practices. Universities implemented LA have been successful at assessing and predicting student's performance, monitoring and motivating them discovering undesirable learning behaviors and their emotional states, helping educators and administrators to unlock big data potentials and then making quicker data driven

decisions. In today's world there is a close relation between Learning Analytics (LA), Educational Data Mining (EDM) research fields, since EDM and LA as to turn raw data into actionable insights making education-related decisions better. Based on the nature of the analysis of big data in the learning environment, both EDM and LA were aimed at improving quality education by improving interventions. Indeed, the era of digital transformation brought the emergence of a large collection of application / tools to conduct research in EDM and LA especially in online activities compared to traditional system. Furthermore, Artificial intelligence (AI) and Machine Learning (ML) appeared as mechanisms used in data management towards financial value.

This paper intends to examine the rising value of the data in contemporary higher education. For this reason, the impact and effective use of data and its components are analyzed and explained with their outcomes in the globalized as well as competitive atmosphere of this dynamic sector. The paper is organized as follows. The next section provides data and methodology. The following section covers findings. The final section includes the concluding remarks.

2. DATA AND METHODOLOGY

A literature review was conducted to reflect the advantage provided by the effective use of data and its component to predict and improve the academic success. The selected topics were Big Data in higher education, Educational Data Mining (EDM), Learning Analytics (LA) to predict and improve student success, Artificial Intelligence (AI) and Machine Learning (ML) in data management towards financial value, data management as an integral part of 5th Generation (University 5.0) universities. All the selected topics were deeply examined under the perspective related to the position of higher education institutions in front of the rising value of data. The aim was to analyze the outputs and reach findings concerning the requirement of a data-driven policy in the universities in the globalized competitive higher education sector.

3. FINDINGS

Globally, the landscape of higher education sector is under increasing pressure to transform its operational and governing structure; to accommodate new economic, social and cultural agendas; relevant to regional, national and international demands. As a result, universities are constantly searching for actionable insights from data to generate strategies they can use to meet these new demands. Big Data and analytics have the potential to enable institutions to thoroughly examine their present challenges, identify ways to address them as well as predict possible future outcomes (Daniel, 2017). The term Big Data refers to an exponentially increasing volume of heterogeneous data which is differentiated from traditional data based on its volume, variety, veracity, velocity, and value. The proliferation of mobile devices and the rapid development of information and communication technologies (ICT) have seen increasingly large volume and variety of data being generated at an unprecedented pace. Big Data have started to demonstrate significant values in higher education (Ang et al., 2020). The emergence of big data in educational contexts has led to new data-driven approaches to support informed decision making and efforts to improve educational effectiveness. Digital traces of student behavior promise more scalable and finer-grained understanding and support of learning processes, which were previously too costly to obtain with traditional data sources and methodologies. Types of big data are listed as Microlevel big data (clickstream data), Mesolevel big data (text data) and Macrolevel big data (institutional data) (Fischer et al., 2020).

The emergence of Educational Data Mining (EDM) played a significant role in discovering patterns of knowledge about educational phenomena and the learning process predicting student performance, retention, success, satisfaction, achievement and dropout rate. The process of EDM is an iterative knowledge discovery process that consists of hypothesis formulation, testing, and refinement (Moscoso-Zea et al., 2016 ; Sarala and Krishnaiah, 2015).

Figure 1: Knowledge Discovery Process in Educational Institutions
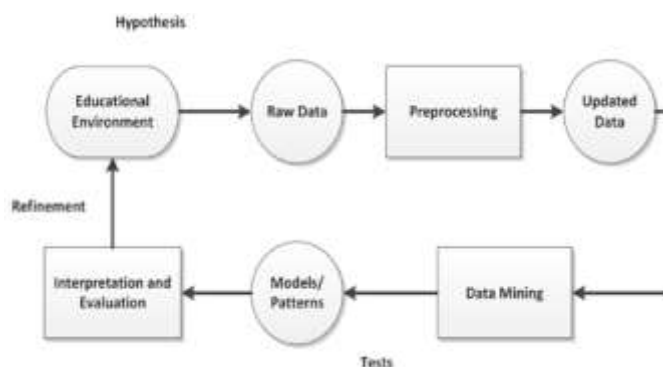
Source: Moscoso-Zea, O., Andres-Sampedro, & Lujan-Mora, S. (2016). Datawarehouse design for educational data mining. In 2016 15th International Conference on Information Technology Based Higher Education and Training (ITHET), (pp. 1–6).

Educational data Mining (EDM) is a specialized form of data mining focused on utilizing data derived from educational environments and aimed at addressing educational issues and enhanced the overall learning experience, performance, and outcomes. Its kick-off happened in the 21st Century due to the application of Data Mining in the education arena has given birth to the Educational Data Mining (EDM). It is used to classify, analyze, and predict the students' academic performance beside their dropout rate, as well as instructors' performance in order to improve teaching and learning process (Aulakh et al., 2023)

Figure 2: Extraction of Knowledge' Component of EDM
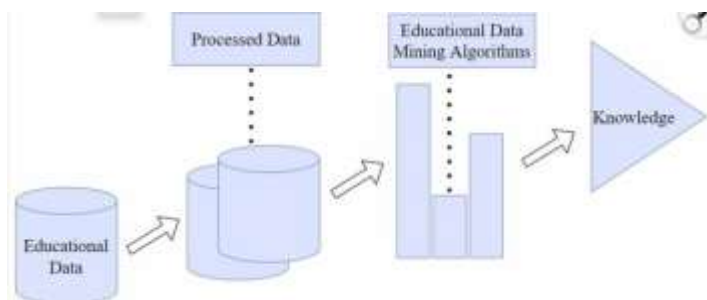
Source: Aulakh, K., Roul, R. K., & Kaushal, M. (2023). E-learning enhancement through educational data mining with Covid-19 outbreak period in backdrop: A review. International journal of educational development, 101, 102814.

The tremendous growth in electronic data of universities creates the need to have some meaningful information extracted from these large volumes of data. The advancement in the data mining field makes it possible to mine educational data in order to improve the quality of the educational processes Owing to digitization of academic processes, universities are generating a huge amount of data pertaining to students in electronic form. It is crucial for them to effectively transform this massive collection of data into knowledge which will help teachers, administrators and policy makers to analyze it to enhance decision making. Furthermore, it may also advance the quality of the educational processes by providing timely information to different stakeholders. The purpose of data mining methods is to extract meaningful knowledge from data (Han and Kamber, 2006). The application of data mining methods to educational data is referred to as Educational Data Mining (EDM) (Baker and Yacef, 2009). Baker (2010) also proposes five primary categories or approaches in EDM: prediction, clustering, relationship mining, discovery within models, and distillation of data for human judgment. The present work combines three approaches: prediction, clustering and, to some extent, distillation of data for human judgment.

Learning Analytics (LA) is an interdisciplinary scientific field which examines the way in which data can be used to improve the overall learning quality and to address a variety of educational challenges and issues. It is closely related to EDM and fulfill activities such as measurement, collection, analysis and reporting of students' data to predict performance and improve success (Kaur and Dahiya, 2023). Furthermore, it provides the process of collecting, evaluating, analyzing and reporting organizational data for decision making. The purpose is to improve learning processes developing more engaging and effective teaching and learning techniques. For this reason, LA plays a vital role in decision making support and selection of suitable timely intervention (Amare and Šimonová, 2021). Indeed, LA leverages leveraging learner related data to generate reliable and factual information for the purpose of enhancing decision making in higher education. It also allows faculty, institutions, and students to make data-driven decisions about student success and retention and cost saving (Okewu and Daramola, 2017).

LA offers the promise of more personalized learning enabling students to have more effective learning experiences providing benefits for all levels of stakeholders such as mega-level (governance), macro-level (institution), meso-level (teacher), micro-level (student) (Gaftandzhieva et al., 2018).

Table 1: Learning Analytics Tolls

Country	Institution	Case Study/Project	Summary
USA	Purdue University	Traffic Signals and interventions	Improve student's success at the course level;enhance student's retention rate.
	University of Maryland	LCMS (Blackboard)	Traces student's activities and predict their success rate; focus on early intervention to improve student's trajectory.
	New York Institute of Technology	Identifying at-risk students using the STAR model	The aim was to enhance the retention rate of students by deploying a Student At-Risk model
	California State University	LMSS	Better predict student success via multiple demographic variables than using traditional methods
	University of Michigan	E2Coach	Leveraging analytics to support students with course decisions; acts as an intervention engine
	Rio Salado Community College	PACE (Progress and Course Engagement)	Track improvement of students in courses; early intervention to predict at-risk students
	Northern Arizona University	GPS (Grade Performance System)	Student alerts for resolving their educational issues and enhance their success

NETHERLANDS	Erasmus University Rotterdam	STELA (Successful Transition from secondary to higher Education using Learning Analytics)	Focuses on providing formative and summative feedback to students in the transition; scalability and transferability solutions
AUSTRALIA	Edith Cowan University	C4S (Connect for Success)	Improved retention and success rates of students
	University of New England	AWE (Automated Wellness Engine)	Aimed at early identification of students who were struggling with their study programs
	Open University Australia	PASS (Personalised Adaptive Study Success)	Track students' performance to enhance study success
	University of Wollongong	SNAPP (Social Networks Adapting Pedagogical Practice)	Support teacher to evaluate student behavioral patterns during the course; timely intervention
UK	University of Central Lancashire	Student performance, retention, and progression	Track student progress in course; intervention
	Open University	Student engagement, retention and progression	Track student progress in course; intervention
	University of East London	Student lifecycle and performance benchmarking	Track student progress in course; intervention
	University of Sheffield	Student admission and progression	Student support and intervention
	University of Manchester	Facilities and utility optimization	Student support and intervention
	University of Bedfordshire	Student engagement, retention and progression	Track performance of students and predict their success

Source: Hooda, M., & Rana, C. (2020). Learning analytics lens: Improving quality of higher education. International journal of emerging trends in engineering research, 8(5).

In the 21st Century Artificial intelligence (AI) and Machine Learning (ML) appeared as mechanisms evolved from data management and developing processes. Firstly, AI is the theory and development of computer systems to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. Secondly, ML is a branch of AI and computer science focusing on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy. Incorporating these mechanisms into business became a trend in education industry as game-changers enhancing the efficiency and effectiveness of management operations. AI and ML have great potential in universities as online platforms and applications being more closely aligned with learners' needs and knowledge, making the educational process more efficient. Notably, they are considered as essential technologies enhancing learning, primarily through students' skills, collaborative learning in universities. Indeed, they altered the educational world, giving students new skills and providing a collaborative learning environment in the universities with great implications for the near future. So, they represent the present and future in both education and the world's progressive development according to most reputable universities. (Kuleto et al., 2021). Most reputable higher education institutions have understood that AI and ML represent the present and future in both education and the world's progressive development. Such technologies provide an interactive and advanced educational experience to their students. The results are impressive: 65 per cent of universities in the United States of America support AI and ML assisted learning. Moreover, these systems provide valuable assistance to teachers and lecturers in the best schools, facilitating and improving learning in various ways. For example, estimates indicate that AI in education in the United States increased by 47.5 per cent between 2017 and 2021. (Chang, 2017). AI and ML are also improving the security and efficiency of the institution, providing a peaceful, flexible, and accessible computing environment for research and developing skills among students, and a collaborative learning environment in the universities reinforces the importance of AI and ML to enhance customized learning (Kumar, 2021).

Quick rise in the use of AI happened in higher education in the last 5 years. In fact, AIEd (Artificial Intelligence in Education) is significantly used for assessment/evaluation, predicting, AI assistant, intelligent tutoring system, and managing student learning (Crompton, 2023). Expected goals have been to increase outcomes, access and retention as well as decrease cost of operations and time for completion (Klutka et al., 2018).

People also have noticed significant advancements in the higher education ecosystem due to ongoing digital transformation, particularly through the integration of AI and 5G wireless technology. Specifically, arguments on AI have been based on not only to enhance the efficiency and effectiveness of management operations within higher education institutions, but also to provide invaluable assistance to academics and students in the educational process enhancing academic output. Therefore, new and attractive learning experiences for students enables more personalized and adaptive learning approaches. Indeed, increase in access to education offers greater flexibility, mobility, and convenience in the globalized higher education market (Eskinat and Teker, 2024).

AI will open up many educational opportunities for higher education, and institutions that make the investment necessary to utilize it will realize significant benefits. The use of technology or teacher bots in higher education is an increasingly attractive solution as enrolment increases, and class sizes, staffing costs, and finances for universities grow (Popenici and Kerr, 2017). This became evident when massive open online courses (MOOC) enlightened the imagination of many university administrators. With these "open courses," there are no enrolment requirements or fees, and online students from anywhere in the world could enroll and participate. These two forces were a boon to universities in that they allowed them to market globally for students, leading to an enormous number of new students. Furthermore, algorithms are increasingly used in schools to market prospective students, estimate class size, plan curriculum, and allocate resources, like financial aid and facilities. Thus, AI is becoming increasingly important, as financial and enrolment pressures in higher education become more prevalent. This has necessitated the development of low-cost technologies capable of providing students with personalized support

and service. For example, chatbots and other instant self-service technologies can enable higher education institutions to be more innovative (Kuleto et al., 2021).

The importance of data management from the perspective of the business management process, where big data is the most crucial and pressing technical and business issue in the modern realm of technology. A data-driven culture in the organization with the help of strategizing in terms of data collection, analytics and data management by establishing governance and regulatory practices to ensure data security and integrity (Sabri and Amir, 2024).

As far as the structure of higher education is concerned there are currently five different generations of universities. The first-generation University 1.0 initiated as information transfer centers in the 11th Century. Later, the second-generation University 2.0 appeared as information transfer and research centers in the 19th Century. 1970s brought the third generation University 3.0 as information transfer, research and application (university-industry) centers. Then, the fourth-generation University 4.0 flourished as a digitalized university depending on the technological and social innovations under the storm of digital transformation age of the 2000s. Lastly, fifth-generation University 5.0 with its foreseen rise by the 2030s named as digital university targeting all world as a single market and providing all-education services in a translocal and transtemporal form globally are at the stage depending on digital transformation era's major technological innovations. (Eskinat and Teker, 2023). At this point, data management is considered as an integral part of the 5th Generation universities (University 5.0).

Analysis shows that, Big Data and EDM in discovering patterns of knowledge about educational phenomena and the learning process predicting student is effective in this era. The role of LA in predicting student performance will continue to have critical importance to better compete in the globalized higher education. Notably, rethinking and redesigning data management towards financial value and accepting the influence of AI and ML as game changer is a matter of fact in today's world of digital transformation. Then, increasing digitalized expectations of Generation Z, and a foreseen storm of Generation Alpha in the context of Industry 5.0 and Society 5.0. should also be taken into consideration (Eskinat, 2023).

4. CONCLUSION

Academic Success is considered as an essential criterion for assessing the quality of higher education institutions in the 21st Century. So, universities need to perform the effective use of data particularly in the context of new era like Industry 5.0, Society 5.0 and University 5.0. For this reason, higher education institutions have to follow a data- driven culture as greater demands of universities already appeared for retention, completion and graduation rates of students in the globalized competitive higher education sector announcing to improve student success.

The effective use of Educational Data Mining (EDM) and Learning Analytics (LA) is going on for the last two decades. Whereas EDM translates the data into meaningful actions to support and empower the learning steps, LA is a human-lead process predicting learners' performance as well as identifying potential problematic issues of students (Vaidya, A., & Saini, J. R. ,2021). Indeed, the essential role of EDM and LA higher education institutions worldwide is to improve the quality of learning, student success and retention, to delivery automatic and immediate feedback, and to provide a personalized experience for students. Furthermore, the influence of EDM and LA on the current educational system provides opportunities for new learner-centered tools and smart learning environments bringing customized experiences and meeting students' specific needs to be developed.

At this point, Artificial intelligence (AI) and Machine Learning (ML) are two mechanisms evolved from data management and developing processes. It may be argued that, AI and ML are two impressive game changers having great potential for universities altering educational world from the financial perspective.

As a result of this study, one should consider the effective use of data and its evaluation components, namely Educational Data Mining (EDM), Learning Analytics (LA), Artificial intelligence (AI) and Machine Learning (ML), as the integral part of Fifth Generation Universities (UNIVERSITY 5.0) era in the globalized competitive higher education sector.

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