Chapter 10

Data-Driven Decision Making in Education: Role of Big Data technologies

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Abstract

Personalized learning, improved accountability, and data-driven decision-making represent a few of the advantages of education datafication. It enables the modification of educational approaches to individual student requirements, hence improving educator effectiveness and the achievement of students. However, other academics suggest that datafication could contribute to excessive dependence on data, jeopardizing teacher competence and judgment. Ensuring ethical data usage in education is extremely important since the quality and nature of data accessible might restrict decision-making accuracy. Quality should be viewed as an ongoing improvement process rather than a static endpoint, with an emphasis on continuous progress rather than goal-oriented. A data- driven decision-making process is presented in the study to assess the applicability, acceptance and usefulness of new technologies such as AR to raise educational standards. A user centered approach to assessing augmented reality applications in education is covered with a focus on how individual variances affect IT adoption and acceptability. a modern technological advancement, AR can be used to raise educational levels. Emerging domains like AI and big data analytics use algorithm to evaluate data and offer more insight. In order to help educational institutions make data driven decisions, the article discusses a method that uses ML algorithms to examine student data, success rates and curriculum creation. In order to enhance the quality of education this study explores how big data affects school leadership. Scholarly journals, novels and seminar papers were among the many sources from which the data were gathered. This study used an interactive qualitative methodology that comprised data collection, reduction, presentation and conclusion drafting in addition to a library research strategy. Enhancing the use, advantages and difficulties of big data in school administration is the aim of findings.

Keywords

Data-Driven Decision-Making (DDDM), Global Educational Reform, Digital Assessment, Digital-Based Educational Management Systems, Decision Support System (DSS)

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1. Introduction

The increasing integration of data in decision-making in education, known as datafication, is driven by an objective for superior educational outcomes and strengthen accountability. Advances in technology and the availability of vast amounts of data on student performance, teacher effectiveness and school operations have accelerated this trend. However, the positive and negative aspects of data-driven decision-making should be investigated, as they can lead to enhanced educational results. Concerns regarding privacy, data quality, and possible data misuse have risen as data availability has increased [1]. Technology has transformed education by enabling teachers to incorporate data and analytics in the classroom. Teachers can evaluate students' comprehension in real time and provide them with homework assignment statistics. Teachers can utilize online platforms to assign videos with questions, track viewer performance, and utilize findings to create lessons, group students, scaffold learning activities, and distinguish learning. Data analytics may also help eliminate educational gaps and enhance teaching approaches [2]. Data-driven decision making (DDDM), which is an extension of test-based accountability measures in educational reform, provides fresh insights into effective leadership. However, the implementation of this paradigm, particularly in power dynamics, raises basic concerns, particularly in the framework of educational discourses [3]. Higher education institutions (HEIs) are rapidly embracing information and communication technology (ICT) for financial, administrative, and learning goals, resulting in a proliferation of data formats. This has made it difficult for decision-makers to obtain consolidated data. Business intelligence tools and big data technology can assist in making effective decisions based on readily available data sources. However, integrating big data remains a hurdle, prompting additional research to develop successful big data analytics solutions [4]. Academic decision-makers are increasingly relying on immense amounts of data for making intelligent choices, but this does not ensure superior choices. They must employ contextualized information and analytics, taking unique circumstances and demographics into account, all while keeping privacy, ethics, and ethical data usage in consideration. Leaders must also examine effective data analytics, data governance, and organizational strategies to assist informed decision-making while simultaneously addressing security and privacy concerns [5].

Global educational reform is driving economies to improve their teacher education and professional development systems in order to generate outstanding educators. In figure 1 shows that Data-driven educational choices are essential for improving the quality of education. Mining pedagogical big data requires multidisciplinary skills involving statistics and machine learning to extract relevant information from enormous amounts of data. This contributes to a better understanding of educational phenomena and enhances decision-making in education [6]. The integration of internet of things (IoT) technology in educational institutions is critical for DDDM, considering the complexity of educational environments necessitates the capacity to collect, evaluate, and capitalize on data. These technologies have the potential to increase administrative efficiency, optimize campus operations, and strengthen the educational experience. However, data privacy, security, and effective data governance frameworks must be addressed in order to improve educational decision-making [7]. Digital traces of student activity provide a more scalable knowledge of learning processes, which was previously impossible to gather from traditional data sources. Natural language processing (NLP) approaches analyze student-created datasets and relate linguistic elements to cognitive, social, behavioral, and emotional processes. Course guidance and early warning systems take advantage of institutional data to improve decision-making. Balancing data privacy, educating academics, and resolving conflicts between explanation and prediction are some of the challenges [8].
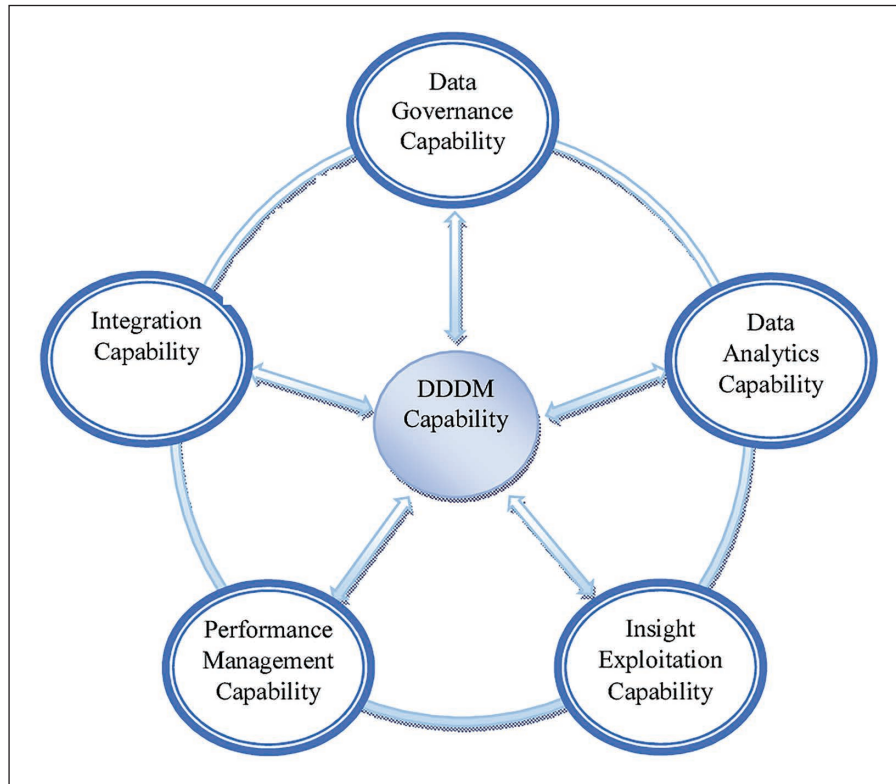
Fig 1: Concepts regulation of DDDM

2. Data-Driven Decision Making in Education: Role of Big Data technologies

Big data technologies have emerged dramatically throughout education over the past 20 years, resulting in artificial intelligence (AI) playing an increasingly important role in decision-making. New technologies are being utilized to evaluate an enormous amount of data, enabling more effective decision-making leveraging information and communication technology (ICT). This trend is expected to continue, compelling educational leaders to create learning management systems to effectively utilize big data for decision-making [9]. As ICT advances, Bigdata has evolved into a significant topic for educational administration. The amount of data generated in learning environments has risen dramatically, including data regarding learners, educators, curriculum, exam results, and participation. New technologies, especially digital-based educational management systems, online learning platforms, and digital assessment tools, have enabled more extensive and comprehensive data collecting [10]. Digital assessment is a significant area in education, with a focus on data modification and utilization of ICT for internal educational growth. Data-driven decision-making (DDDM) makes utilization of questionnaire-generated data. The results demonstrate considerable improvements in ICT integration in elementary education, as well as ICT culture and components including teachers' self-perceptions of ICT usage, digital competence,

content utilization, pedagogical assessment, online interaction with parents, and digital assistance for educational administrators [11]. DDDM is an approach which employs data for influencing educational decisions, with a focus on formative assessment data to lead pedagogical modifications. Despite its significant influence on learning outcomes and the requirement for educational responsibility, a handful educators completely adopt DDDM. Despite its promise, DDDM has only recently received attention in the field of education [12]. During the COVID-19 epidemic emergency, K-12 educators adopted DDDM techniques for distance learning. Combining quantitative and qualitative methods, to looks into how teachers' data utilization evolved during the pandemic as well as what data they would prefer to receive for better decision-making. It is based on the Universal Design of Learning (UDL) methodology, which defines many ways of customizing teaching and learning for various learners [13]. Critical data-driven decision making (CDDDM) has expanded greatly as a result of its origins in scientific management, which has had an impact on the implementation of neoliberalism logic. This practice of utilizing statistics to make decisions and monitor classrooms dates back to the beginning of the 20th century. As a result of the global influence of scientific management concepts which prioritize efficiency, order and productivity on educational legislation and process many forms of DDDM have emerged [14]. To improve decision making, the educational leadership decision support system (DSS) uses ML and big data analytics. For strategic planning, resources allocation, student interventions and curriculum development, the DSS analyzes vast amounts of data from student performance, administrative records and institutional resources to produce valuable insights and prediction models. With the help of this real time processing, leaders can make data driven decisions quickly, resolving issues and seizing opportunities in the intricate educational landscape. Using big data analytics in conjuction with the recommender ranking decision support system offers a novel way to enhance educational administration [15]. New technologies are being embraced by the education sector more to aid in decision making. Multimedia, desktop and web OLAP are the three types of online analytical processing queries covered by the DSS implementation roadmap. The use of key performance indicators is used to gauge academic achievement. Ensuring seamless operations in the educational sector, the suggested DSS complies with privacy, security and performance requirements. The utilization of student's academic data for strategic decision making is made possible by this novel technique [16]. Analyzing the usability, acceptability and usefulness of AR as a teaching aid using a DDDM technique. The method's foundations are the ETAS-M and multiple criteria decision analysis, both of which have their origins in the unified theory of Acceptance and Use of Technology (UTAUT). The objective is to determine if AR applications are suitable to specific students' learning styles [17]. Educational institutions experience challenges while controlling decisions influencing their strategies, initiatives, and operations. Machine learning, an emerging discipline of artificial intelligence (AI), employs algorithms to evaluate data and deliver a better understanding. Machine learning can produce precise outcomes and enable informed decision-making whenever an immense amount of high-quality input data for learning is employed, addressing the primary challenges plaguing these organizations [18].

3. Methodology

Big data technologies are used in DDDM in education to improve administrative, instructional and learning procedures. Learning management systems sensors and digital platforms are used to gather data from sources, including student performance, engagement, attendance and behavior patterns [19]. Then to spot patterns, predicts results and customize learning paths advanced analytics are used including ML and predictive modeling. Data insights can be used by educators to make well informed choices regarding

student care, resource allocation and design. In addition to guaranteeing that student progress is tacked and maximized throughout their academic path and data allow for prompts interventions and ongoing development [20].

4. Recommendations

Based on the thorough literature review of data-driven decision making (DDDM) techniques currently being employed by the education sector, we propose following recommendations for the future.

- The rapid growth of ICT encourages curriculum optimization in data-driven educational decision-making systems, thereby enhancing teaching quality and encouraging conventional education reform and advancement.
- Big data enhances administrative choices by delivering timely data and strengthening the effectiveness of educational leaders' managing responsibilities.
- Decision-making is critical when developing plans, and big data provides accurate historical analysis and future projection, increasing educational leaders' planning and policies in educational organizations by giving expansive information.
- Big data is critical to the success of educational institutions given that it enables leaders determine the best decision-making on time, increasing efficiency and effectiveness in their operations.
- Big Data enables educational institutions to accurately track students' progress, improving their academic development. This information is used to determine the necessary learning objectives, adjust the learning process and offer the right kind of assistance to boost performance.
- Big data's growing use necessitates that educational programs place a strong emphasis on teaching students' data science techniques and encouraging open science and collaborative research frameworks.
- A major advancement in education has been made with the integration of big data analytics with the RRDS, which highlights the value of data driven insights for improved student outcomes while enhancing instructional strategies, resource allocation and personalized learning application.
- It is projected that the future of education will be significantly impacted by the integration of RRDS and big data analytics in educational institutions, as it will enhance teaching and learning methodologies and promote student performance.
- To enhance successful DDDM, educators should have access to a range of data types, such as motivational, family related and socioemotional data. This data should be easy to use to guarantee its utilization as it is essential in both routine and emergency scenarios.
- Data collection and utilization in educational institutions is ubiquitous, but educators lack the skills to collect and employ it efficiently. The CDDDM paradigm allows teachers to critically analyze the techniques of teaching, rather than merely the objectives.

Conclusion

Educational leaders can make more rapid and accurate judgments in the emerging Big Data era, but they must first understand modern big data technology. This enables them to improve the teaching and learning processes by employing different information and communication technologies. As a result, educational institutions will face increased pressure to develop learning management systems that can efficiently use big data for decision-making. This tendency will raise the requirement for competent

decision-making in education. The incorporation of big data in educational management necessitates data collecting from a variety of sources, including academic, survey, and administrative data. Big data storage and processing must take into account data gathering, handling, security, privacy, analysis, and machine learning. Data analysis for decision making involves establishing goals, choosing relevant methodologies, processing data, extracting insights, and interpreting data. Spreadsheets, statistical analysis software, data visualization tools, machine learning techniques, and data mining tools are examples of commonly used data analysis tools. The DSS depends on an independent educational data, which encounters implementation issues including dealing with paper-based data, creating an ETL package, using OLAP, KPI, and developing and deploying reports. The data source pre-processing step leverages SSMS for converting paper-based student information into electronic data sources, while the ETL package is constructed with SSIS and incorporates activities involving column derivation, missing value filling, surrogate keys, and concept hierarchies. Model design and implementation may be approached using four different methods. In democratic societies, defining the goals and substance of education necessitates a public conversation led by educators who can successfully direct resources toward accomplishments. Without this approach, professional expansion has the potential to de-professionalize and marginalize educators. This study attempts to demonstrate that informed educational leadership, especially DDDM, cannot be achieved without clearly specified objectives, as identifying learning objectives is not the aim in itself.

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