

Transforming Educational Leadership with Data-Driven Approaches: Challenges and Practice

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Abstract

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In contemporary education, schools are increasingly expected to make decisions that are accurate, objective, and responsive to dynamic academic and organizational demands, with digital technologies enabling the adoption of data-driven management as a key strategy. This study examines the application of data-driven management in schools, focusing on its effects on decision-making effectiveness, implementation strategies, and challenges. A qualitative literature review of twelve peer-reviewed international journal articles published between 2019 and 2024 was conducted, using thematic analysis to identify patterns, outcomes, and best practices. The findings indicate that schools implementing data-driven approaches achieve improved operational efficiency, evidence-based policy interventions, and enhanced educational quality, while fostering transparency, accountability, and collaboration among teachers, students, staff, and parents. However, successful adoption requires adequate digital infrastructure, professional training, leadership commitment, and a supportive organizational culture. Data-driven management thus offers a sustainable framework for optimizing school performance and resilience in the digital era.

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1. Introduction

In today's era of digitalization and information, educational institutions at all levels encounter increasingly multifaceted challenges, extending beyond administrative matters to include academic, social, and organizational cultural dimensions. Modern schools are expected to respond to changes swiftly and accurately, with evidence-based approaches, particularly in managing policy shifts, curriculum updates, and rapid technological advancements. In this context, the ability of schools to make informed and effective decisions plays a crucial role in determining their performance, operational efficiency, and long-term sustainability.

Relying solely on intuition, past experiences, or informal judgment is no longer adequate for effective decision-making in contemporary schools. Instead, strategic decisions must draw on accurate, objective, and relevant data, systematically and consistently accessible to all stakeholders. Consequently, data-driven management has emerged as a strategic and highly pertinent approach to addressing the demands of modern education. This management paradigm emphasizes the central role of data in guiding planning, policy implementation, and the evaluation and monitoring of all school-level managerial activities.

The data involved can come in many forms and from various sources, ranging from student academic records, learning outcomes, and attendance rates, to teacher performance metrics, efficiency of school budget utilization, and satisfaction levels reported by parents, students, and teachers themselves. When these data are properly collected, managed, and analyzed, they serve as a crucial tool for making decisions that are objective, accurate, and sustainable.

Adopting this paradigm naturally requires significant adjustments, not only in technical areas such as implementing school management software, academic information systems, and evaluation dashboards, but also in cultural and structural dimensions. This includes fostering an organizational culture that values transparency, accountability, data-informed collaboration, and participatory decision-making. Within this framework, data-driven management enables school principals and educational management teams to identify patterns from historical and real-time data, anticipate potential challenges, and design interventions that are timely, adaptive, and closely aligned with the actual needs of the school community.

The growing complexity of challenges in education has highlighted the need for management models that are adaptive, responsive, and grounded in accurate data analysis. Research by Gaftandzhieva et al. (2023) demonstrates that educational institutions adopting a data-driven approach are better able to enhance operational efficiency and develop more effective curriculum strategies. Similarly, Kenno et al. (2021) emphasize the critical role of data-informed budget management in ensuring a more equitable, transparent, and efficient allocation of educational resources.

Nevertheless, implementing data-driven management in schools is not without its obstacles. Common challenges include limited technical skills among educators to interpret and utilize data, insufficient systematic training, weak integration among school information systems, and resistance to changes in traditional work practices and managerial culture.

In response to these issues, this article aims to provide both theoretical and practical insights into the data-driven management model in educational settings. By

reviewing academic research and international studies from the past five years, the article explores the key components, strategic advantages, and common challenges encountered in applying this model. The findings are expected to serve as a practical and reflective resource for policymakers, school principals, education practitioners, and academics seeking to develop school management systems that are adaptive, data-based, and effective in today's rapidly evolving digital era.

2. Literature Review

2.1 Improving Educational Outcomes through Data-Driven Approaches

Data-driven management in schools refers to a systematic and sustainable approach that structures the collection, processing, analysis, and use of reliable, verifiable information to support effective and efficient managerial decisions. This management model evolves alongside the advancement of information technology and the growing expectations of communities and stakeholders for accountability in various aspects of school governance. According to Gaftandzhieva et al. (2023), data serves as the core foundation and strategic reference for school education policies, encompassing areas such as curriculum planning, human resource management, and ongoing monitoring of student learning outcomes. The process typically involves the use of tools like educational management information systems (EMIS), indicator-based evaluation dashboards, and integrated data analytics platforms.

Wang (2021) highlights that schools adopting a data-driven management system are able to enhance the accuracy of policy formulation and minimize errors in decision-making. This aligns with Acton (2021), who asserts that school leadership

grounded in data is more responsive to students' actual needs and to the constantly shifting dynamics of the educational environment. Principals and school leaders must interpret data patterns effectively to design targeted interventions, such as reducing absenteeism or sustainably improving student performance.

2.2 Integrating Technology and Analytics for Effective School Management

School effectiveness is not solely determined by academic results, such as exam scores or graduation rates, but also encompasses several other crucial dimensions. These include the efficiency of resource management, the creation of a supportive work environment for teachers and staff, and the extent to which both internal and external stakeholders are meaningfully engaged. In this regard, the strategic and sustainable use of data has been empirically shown to enhance performance across these areas. For instance, Kenno et al. (2021) demonstrate that employing data in the educational budgeting process can significantly improve fund allocation mechanisms while reducing the likelihood of budgetary inefficiencies within schools.

From a more technical standpoint, Nguyen et al. (2024) highlight that integrating machine learning with the fuzzy AHP method in school managerial decision-making systems substantially boosts efficiency in risk management and contributes measurably to the overall quality of educational services.

In terms of human resource development, Matar et al. (2024) emphasize the critical role of data analysis in evaluating teacher performance and designing targeted professional development programs. Data is not only used to assess student outcomes but also serves as a basis for customizing training and capacity-building

strategies that are contextually relevant. This approach fosters a reflective, adaptive, and forward-looking work culture within the school environment, promoting continuous improvement across all levels of management and practice.

2.3 Building Competence, Infrastructure, and Collaboration for School Data Systems

Although schools possess significant potential and strategic opportunities, the implementation of data-driven management is still confronted with a range of complex challenges. A primary issue is the limited technical capacity of educational actors in analyzing, interpreting, and utilizing data effectively. Research by Palah et al. (2022) indicates that many teachers and administrative staff lack sufficient data literacy, which hinders their ability to leverage data as a reliable foundation for decision-making. This challenge is further compounded by the scarcity of systematic training programs and inadequate incentives for educators to consistently apply data-driven practices in their daily work.

Another critical obstacle lies in the fragmentation of information systems within the school's organizational framework. As noted by Heeks and Ospina (2019), numerous schools still operate multiple, standalone information systems that are not interconnected. Consequently, the data generated often remains unsynchronized, difficult to analyze across departments, and is frequently not actionable in a timely manner. These issues underscore the urgent need for an integrated, user-friendly, and easily accessible school management information system that can serve all stakeholders, both internal and external.

To overcome these challenges, studies recommend comprehensive and context-specific strategies. First, long-term priority should be given to training and enhancing the analytical competencies of school principals and teachers. Second, the development and reinforcement of digital infrastructure, including the integration of EMIS with platforms for teacher and student performance evaluation, should be pursued systematically. Third, adopting a collaborative and participatory management approach that engages teachers, students, parents, and other external stakeholders can strengthen data validity while simultaneously improving transparency and accountability within the educational institution.

3. Methods

This study employs a qualitative approach through a literature review (library research) methodology, aiming to identify, evaluate, and analyze data-driven management models to enhance decision-making effectiveness in schools. The literature review method was chosen for its ability to provide a comprehensive conceptual framework as well as relevant empirical evidence from diverse academic sources, particularly international journal publications. By examining existing literature that has been peer-reviewed and academically recognized, this approach enables researchers to gain a thorough understanding of data-based educational management practices.

The primary sources of data for this research were scientific journal articles retrieved from the Google Scholar platform. The article selection process followed specific inclusion criteria: firstly, the publication date must fall between 2019 and 2024; secondly, the article must be a peer-reviewed scientific publication; thirdly, it

should focus specifically on data-based educational management or data-driven decision-making in educational institutions; and finally, the article must be written in English to ensure alignment with international academic standards.

This study followed a systematic process consisting of four main stages. The first stage involved conducting a literature search using keywords such as “data-driven management in education,” “data-based decision-making in schools,” and “educational information systems” to locate relevant articles. In the second stage, the literature was carefully filtered by examining abstracts and assessing topic relevance, ensuring that the selected articles were both in-depth and practically applicable. The third stage entailed analyzing each article through thematic coding to uncover patterns, key concepts, significant findings, and challenges associated with implementing a data-driven management model. Finally, the coded data were interpreted and synthesized to identify the core elements of the data-driven management model and its influence on improving decision-making effectiveness in schools.

To maintain the validity of the study, data triangulation across multiple sources and a critical evaluation of each reviewed article were applied. It is important to note that the research does not aim to generalize but rather to provide a thorough theoretical and practical contribution to contemporary educational management. Although this approach has limitations, such as the absence of primary data and the potential for subjective interpretation by the researcher, a meticulous analysis process and the use of credible academic sources enable the study to offer a comprehensive understanding. This understanding can serve as a foundational

reference for the broader and contextually relevant development of data-based educational policies.

4. Results and Discussion

The analysis of twelve in-depth international scientific articles indicates that implementing a data-driven management model has a profound impact on the effectiveness of decision-making in educational institutions, particularly at the school level. A recurring pattern across these studies reveals that schools adopting a data-driven approach experience notable improvements in multiple managerial areas. These improvements include enhanced operational efficiency, greater precision in formulating policy interventions, overall elevation in the quality of educational services, and significantly higher engagement from various stakeholders, such as teachers, students, administrative personnel, and parents.

According to Ethan (2023), the structured and sustainable application of data in evaluating faculty performance and in planning and assessing curriculum outcomes enables teaching strategies to be more adaptive and closely aligned with student needs. In this framework, data serves not merely as a monitoring tool but also as a basis for reflection and a catalyst for ongoing improvement. School principals and management teams utilize information such as student assessment results, daily attendance records, and teacher performance data to identify necessary training programs and to design academic strategies that are both efficient and effective. The study also emphasizes the critical importance of integrating existing

school information systems to facilitate real-time data access and support collaborative efforts across different departments.

In addition, Wang (2021) highlighted that data-driven decision-making is not merely about gathering large volumes of data, but rather about how the collected data is analyzed and accurately transformed into a focused organizational strategy that produces tangible results. Within contemporary education systems, data-informed leadership plays a crucial role in enhancing the efficiency of educational institutions. The study also underscores the importance of having a decision-making team that not only recognizes the value of data but also possesses strong data literacy skills and the ability to think in a systemic, strategic manner.

Without strong and precise skills in interpreting data, the information collected can become irrelevant or even misdirect policy decisions. Therefore, the capacity to analyze and interpret data is a critical component of an effective data-driven management framework. Research by Kenno et al. (2021) further supports this view, emphasizing the central and indispensable role of data in budgeting and overall school resource management. By adopting a data-based approach in the budgeting process, schools are better able to identify potential areas of waste, establish rational spending priorities, and optimize resource allocation in a fair and efficient manner.

Meanwhile, Nguyen et al. (2024) highlight a more advanced technological approach by demonstrating the application of a hybrid machine learning model in educational decision-making. By integrating the fuzzy AHP algorithm with the principles of explainable AI (XAI), school principals are able to prioritize managerial

strategies based on a range of quantifiable school performance indicators. This integration results in a school management system that is highly adaptive to changing conditions and capable of forecasting potential risks or failures. Such findings provide concrete evidence that a data-driven approach is not only relevant but also essential in the context of contemporary education, which is increasingly dynamic and fraught with complex challenges (Selwyn & Gašević, 2020).

In a separate study, Matar et al. (2024) found that implementing a Business Intelligence (BI) system in schools provides substantial support for a more strategic and structured decision-making process. The study highlights that integrating data from different school units, academic, financial, and administrative, enables evaluations and planning to be grounded in actual evidence. Similarly, Palah et al. (2022) emphasize the crucial role of a data-driven approach in enhancing the overall quality of education.

This study indicates that schools that consistently rely on data for decision-making have demonstrated success in enhancing the effectiveness of teacher supervision, establishing realistic and measurable achievement targets, and optimizing the use of learning technologies in the classroom. At the same time, the research emphasizes that a shift in organizational culture within the school is a critical prerequisite for fully adopting and sustaining a data-driven approach.

On the other hand, despite the clear benefits, most of the studies reviewed also highlight that implementing a data-driven management model presents several complex challenges. Heeks and Ospina (2019) point out that one of the most common obstacles is the low level of data literacy and the limited availability of

training for educators. Many teachers and school principals are still unfamiliar with using information management systems or lack foundational skills in analytical tools, which makes it difficult for them to fully and effectively utilize data.

Another challenge highlighted across several studies is the issue of integrating information systems and the limited access to complete and accurate data. Acton (2021) notes that many schools continue to carry out administrative and managerial tasks manually or rely on isolated, unconnected digital systems, which complicates cross-domain and cross-functional analysis. To address these challenges, various academic articles have proposed strategies. For example, Suryanarayana et al. (2024) recommend implementing a data-driven total quality management (TQM) approach. Within this framework, data serves as the foundation for designing a continuous improvement cycle supported by systematic feedback from all stakeholders, including students, teachers, parents, and school staff. This approach highlights the urgency of not only evaluating final outcomes but also assessing the quality of the processes and inputs that underpin organizational performance, thereby providing a comprehensive, measurable, and actionable understanding of the institution's functioning.

Another study by Mohamed Hashim et al. (2022) highlights the critical role of transformational leadership in promoting and facilitating the adoption of a data-driven culture within schools. In this context, school principals are expected to act as change agents who not only encourage the use of technology but also foster key values such as management transparency, cross-functional collaboration, and high accountability in decision-making. When consistently cultivated, this culture can

create a school management system that is more open, participatory, and grounded in objective evaluations that are continuously updated and improved (Peurach et al., 2019).

In summary, this discussion reinforces that data-driven management is not only highly relevant but also practically essential in contemporary education. Its successful implementation requires readiness not only in technology and digital infrastructure but also in human resources, along with a willingness and capacity to embrace changes in organizational culture that support data-informed decision-making. For schools aiming to grow and evolve as modern learning institutions in the digital era, placing data at the core of all policies and strategies is both a necessity and a strategic imperative.

5. Conclusion

The adoption of a data-driven management model in schools has been shown to significantly enhance the effectiveness of decision-making. A thorough literature review of international scientific studies published between 2019 and 2024 revealed that using data in school management not only improves administrative and operational efficiency but also elevates overall educational quality. Decisions grounded in data are more precise, objective, and responsive to the real needs of students, teachers, and other stakeholders. Additionally, this approach promotes transparency, accountability, and collaborative practices within educational institutions, creating a more open and participatory management environment.

Nevertheless, successfully implementing a data-driven approach requires adequate digital infrastructure, high levels of data literacy among educators, and a committed leadership that fosters a work culture supportive of systematic data use. Challenges such as limited training, fragmented information systems, and resistance to change must be addressed through integrative, participatory strategies. As a strategic and sustainable model, data-driven management equips schools to be adaptive and innovative, emphasizing the importance of investing in robust information systems, professional development for educators, and cross-unit data integration. By doing so, data can be maximized as a primary instrument for informed decision-making that positively impacts the entire educational community.

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