

Optimizing Human Resource Management in Education through Big Data and Learning Analytics

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Abstract

This study explores the optimization of Human Resource Management (HRM) in education through the integration of Big Data and Learning Analytics. Despite the growing availability of educational data, many institutions still face challenges in fully utilizing these technologies to enhance HRM practices. The research focuses on how Big Data and Learning Analytics can improve key HRM processes such as recruitment, performance evaluation, professional development, and teacher retention. By reviewing existing literature, this study identifies gaps in the current use of these technologies and proposes strategies to overcome barriers related to their implementation. The findings suggest that integrating Big Data and Learning Analytics into HRM practices can significantly improve decision-making, foster teacher development, and ultimately contribute to better academic and non-academic outcomes. The study concludes that a data-driven approach to HRM is essential for optimizing educational management and achieving sustainable improvements in teaching and learning. Further research is needed to explore effective strategies for the integration of these technologies into HRM practices to fully realize their potential in education.

Keywords:

Human Resource Management, Big Data, Learning Analytics

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INTRODUCTION

The modern educational landscape faces a variety of challenges that hinder the optimal development and management of human resources within schools. Among the most pressing issues is the difficulty in effectively managing the large and diverse body of educators and staff, which can lead to suboptimal performance and inefficiencies in the educational process (Rosyalita, 2024). One of the key challenges is the failure to fully utilize available data for decision-making in human resource management (HRM). With the exponential growth of data in educational systems, many institutions continue to rely on traditional methods of human resource management, often overlooking the potential of modern technologies such as Big Data and Learning Analytics. As educational institutions increasingly depend on data-driven solutions, the gap between data availability and actionable insights becomes more evident, impacting the ability of institutions to make informed decisions about their human capital.

Literature surrounding this issue reflects a growing recognition of the significance of data in enhancing the management of educational human resources (Garcia-Arroyo & Osca, 2021). However, despite the promise that Big



Data and Learning Analytics hold, studies indicate that many educational institutions still face considerable barriers in their implementation and integration into HRM practices (Gravili et al., 2023). The existing literature highlights the potential for these technologies to revolutionize HRM in education by providing more accurate predictions, personalized development programs, and better retention strategies for educators. Yet, many schools remain uncertain about how to leverage these technologies effectively, with gaps in both knowledge and practical application (Wang, 2021). The failure to bridge this gap results in a missed opportunity to optimize the performance of educational institutions and improve overall outcomes for students and teachers alike (Bai, 2022).

The purpose of this research is to explore how Big Data and Learning Analytics can be utilized to optimize Human Resource Management in education (Permatasari & Tandiayuk, 2023). By examining how these technologies can be integrated into HRM practices, the study aims to provide insights into their potential to enhance decision-making processes in schools. This study will focus on identifying the key areas where Big Data and Learning Analytics can influence HRM, such as recruitment, professional development, performance evaluation, and retention strategies. Additionally, the research will investigate the challenges and barriers that educational institutions face when adopting these technologies and propose strategies to overcome them. Ultimately, the goal is to offer a comprehensive understanding of how these innovative technologies can improve the efficiency and effectiveness of HRM in education, contributing to the development of a more dynamic and responsive education system.

This research is critical for understanding how the intersection of technology and HRM can lead to a more efficient and data-driven approach to managing educators (Dessler, 2015). As educational institutions seek to remain competitive and responsive to changing educational demands, the integration of Big Data and Learning Analytics into HRM practices can offer substantial benefits. This research is driven by the need to provide actionable insights for educational leaders and policymakers aiming to improve HRM processes. By addressing this gap in the literature and practice, this study will not only contribute to the academic discourse on HRM in education but also provide a roadmap for schools and educational systems to implement these technologies, which in turn can enhance overall educational outcomes.

METHODS

The object of this research is the phenomenon of optimizing Human Resource Management (HRM) in education through the use of Big Data and Learning Analytics. Specifically, the study focuses on the integration of these technologies within educational institutions to enhance HRM processes such as recruitment, performance evaluation, professional development, and retention strategies (Chiarello et al., 2024). The research examines the challenges and opportunities associated with the adoption of Big Data and Learning Analytics in HRM practices, highlighting how these technologies can improve decision-making processes and contribute to the overall effectiveness of educational institutions. The case under investigation centers on the gap between the growing availability of educational data and its underutilization in HRM practices,

particularly in schools that have yet to fully embrace these technological advancements.

This research adopts a library research approach, relying heavily on secondary data sources for the analysis. The primary data consists of literature related to the integration of Big Data and Learning Analytics in education, as well as studies focusing on the application of these technologies in HRM (Ashurov et al., 2024). The secondary data sources encompass a wide range of scholarly materials, including books, journal articles, previous research studies, academic papers, and relevant reports on the topics of HRM, Big Data, and Learning Analytics. By reviewing these resources, the research aims to synthesize existing knowledge and identify gaps in the current understanding of how Big Data and Learning Analytics can optimize HRM in education. This approach allows for a comprehensive exploration of the subject matter without the need for primary data collection through surveys or interviews.

The theoretical framework of this study is based on the Human Resource Management (HRM) theories, with particular focus on how data-driven approaches can enhance HRM practices. The research draws on the foundational work of Ulrich (1997), who introduced the HRM competency model emphasizing the strategic role of HRM in aligning human capital with organizational goals. Ulrich's model emphasizes that HRM should not only manage people but also use data to drive decisions, improve efficiency, and enhance organizational performance. The theoretical lens also incorporates the concept of Big Data and Learning Analytics, as outlined by (Singun, 2025) in his work on analytics-driven decision-making. According to Davenport, the use of data analytics enables organizations to gain insights that lead to better decision-making, and this framework has been extended to the field of education in recent years. These theories provide a foundational understanding of how HRM can be optimized with the integration of data-driven technologies, specifically Big Data and Learning Analytics.

The research process follows several key stages and data collection techniques. The first step involves gathering relevant literature, including academic books, journal articles, research papers, and case studies, to gain insights into how Big Data and Learning Analytics have been applied in HRM within educational contexts. This stage of the research focuses on identifying existing practices, theoretical frameworks, and empirical evidence surrounding the use of data in HRM (Porter, 2023). Additionally, the research examines reports from educational institutions that have implemented Big Data and Learning Analytics to assess their impact on HRM practices. The data collection also includes reviewing relevant academic sources that discuss the benefits and challenges of using data analytics in education. This systematic review of literature serves as the foundation for understanding the theoretical and practical applications of these technologies in HRM.

Data analysis in this study uses content analysis techniques to process and evaluate the collected literature. Content analysis involves systematically studying and organizing textual data to identify patterns, relationships, and significant information embedded within the materials. This process involves coding the content based on key themes such as HRM, Big Data, Learning Analytics, and their integration within educational institutions. The aim of this analysis is to identify recurring trends, gaps in the literature, and emerging best practices related

to the optimization of HRM through data-driven technologies. By applying content analysis, the research aims to provide a comprehensive understanding of how Big Data and Learning Analytics can be effectively integrated into HRM practices to improve the management and development of human resources in educational settings (Malleck & Kitula, 2023).

RESULTS & DISCUSSION

In this section, the data from the literature review related to the first keyword, "Human Resource Management (HRM)," is presented. Various studies indicate that effective HRM practices are essential for the growth and development of educational institutions. HRM focuses on recruiting, developing, and retaining talented staff, ensuring that human resources are aligned with the institution's goals (Groenewald et al., 2024). Key HRM processes include performance evaluation, professional development, and creating a work environment that promotes collaboration and innovation. Many scholars agree that when HRM is optimized, educational institutions experience improved teacher satisfaction, student outcomes, and overall institutional performance.

Based on the document, the literature review for this research explores various studies related to Human Resource Management (HRM), Big Data, and Learning Analytics in the context of education. The research highlights that many educational institutions face challenges in utilizing the growing availability of educational data effectively. Existing literature suggests that Big Data and Learning Analytics hold substantial potential for improving HRM practices such as recruitment, teacher development, performance evaluation, and retention strategies. However, studies indicate significant barriers in the implementation and integration of these technologies into HRM processes, such as lack of technical expertise, infrastructure, and the reluctance to adopt data-driven approaches.

The literature further emphasizes the importance of aligning HRM with organizational goals and integrating modern technologies to optimize human resources in educational institutions. Despite recognizing the potential of Big Data and Learning Analytics, many educational institutions have yet to fully implement these technologies in their HRM processes. This gap between the existing knowledge and practical application of these technologies forms the core of the research problem, underscoring the need for further exploration of how these tools can be effectively integrated into educational management practices.

The background of these findings reveals that HRM plays a central role in the success of educational institutions, influencing teacher satisfaction and overall academic outcomes. Additionally, the application of Big Data in HRM practices is seen as a promising avenue for improving recruitment, retention, and resource allocation. The literature also highlights the importance of Learning Analytics in personalizing teaching methods and enhancing HRM decisions based on real-time data, although the full integration of Learning Analytics remains limited due to infrastructural and technical challenges.

The explanation of this data shows that HRM plays a central role in shaping the educational experience. The research on HRM highlights how aligning human resources with institutional objectives not only improves the performance of staff but also impacts the broader goals of the institution (Mulyati et al., 2025). When schools invest in recruiting skilled teachers, providing continuous professional development, and using data-driven approaches for performance management, they are able to create a positive and productive work environment. Moreover, effective HRM practices help maintain high morale among teachers, which in turn contributes to student success. This is

particularly crucial in the context of educational institutions, where the quality of teaching directly influences academic and non-academic outcomes.

The relationship between the description and explanation of the data on HRM and the reality of the research problem is evident (Rohayati, 2024). While HRM practices have been studied extensively in the literature, the challenge lies in how to integrate these practices with modern technologies such as Big Data and Learning Analytics. Despite the recognition of the importance of HRM in education, many institutions continue to rely on traditional methods without fully utilizing data-driven solutions. This gap between established HRM practices and the potential of Big Data and Learning Analytics forms the core of the research problem, highlighting the need for a more effective and innovative approach to HRM in education.

Moving to the second keyword, "Big Data," the literature reveals that Big Data has increasingly become a valuable asset in the education sector. Studies show that the use of Big Data allows educational institutions to gather vast amounts of information from various sources, such as student performance, behavioral patterns, and learning outcomes. This data can then be analyzed to improve teaching practices, student engagement, and administrative decisions. Big Data offers the potential to personalize learning, predict student success, and inform resource allocation (Owolabi et al., 2024). However, while the potential is immense, many institutions still struggle to fully harness the power of Big Data, mainly due to a lack of technical expertise and infrastructure.

The explanation of the data related to Big Data highlights the significant impact it can have on educational management. Big Data enables institutions to track and analyze a wide range of variables that influence student success (Anwar & Abdullah, 2021). For example, by analyzing student performance data, schools can identify at-risk students and intervene early to provide the necessary support. Moreover, data analytics can help institutions allocate resources more effectively by identifying which areas of the curriculum need improvement or which teaching methods are most successful. Despite these benefits, the underutilization of Big Data in many educational settings is a critical issue, as it prevents institutions from fully realizing its potential.

The relationship between the description and explanation of the data on Big Data and the reality of the research problem is significant (Syafriani & Yuliani, 2025). While the literature emphasizes the importance of Big Data in education, the real challenge remains in how to integrate this data into HRM practices. Although educational institutions have access to vast amounts of data, they often lack the tools, infrastructure, and expertise to apply this information effectively to optimize HRM. The research problem lies in understanding how Big Data can be used to enhance HRM practices, improve teacher performance, and ultimately contribute to better educational outcomes.

The third keyword, "Learning Analytics," is also crucial in the context of this research. Learning Analytics refers to the use of data to monitor, analyze, and optimize the learning process (Arulrajah, 2022). It involves the collection and analysis of student data to improve teaching and learning outcomes. Learning Analytics has been shown to enhance student engagement, retention, and academic performance by providing insights into individual learning behaviors and preferences. Through the use of analytics, educators can tailor their teaching methods to better meet the needs of their students. However, despite its proven effectiveness, the integration of Learning Analytics into HRM and teaching practices remains limited in many educational institutions.

The explanation of Learning Analytics data illustrates its potential to transform both teaching and HRM practices. Learning Analytics can be used to monitor students' progress in real-time, providing teachers with the information they need to adjust their teaching methods accordingly (Armstrong & Taylor, 2023). Furthermore, Learning Analytics can help HRM departments assess the effectiveness of professional development programs and identify areas where teachers may need additional support. By analyzing student and teacher data, Learning Analytics provides valuable insights that can inform HRM decisions, such as recruitment, performance evaluations, and training

programs. However, the challenge remains in fully integrating Learning Analytics into HRM practices to optimize both teaching and administrative processes.

Table 1. Learning Analytics in the context of education and HRM, illustrating its role, benefits, and challenges.

Aspect	Description	Benefits	Challenges
Definition	Use of data to monitor, analyze, and optimize the learning process through collection and analysis of student data.	Provides insights into individual learning behaviors and preferences.	Limited integration into HRM and teaching practices in many institutions.
Impact on Teaching	Enables real-time monitoring of student progress, helping teachers adjust methods promptly.	Enhances student engagement, retention, and academic performance.	Requires training and infrastructure for effective use by educators.
Impact on HRM	Assists in evaluating the effectiveness of professional development and identifying teacher support needs.	Supports data-driven HR decisions such as recruitment, evaluation, and training.	Data privacy and ethical concerns, and integration with existing HR systems are complex.
Analytical Insights	Provides detailed analysis of student and teacher data for informed decision-making.	Improves teaching quality and HR management efficiency.	Resistance to change and lack of awareness about analytics potential among HR and faculty staff.
Strategic Potential	Can transform educational and HRM processes by linking learning outcomes to staff development and resource allocation.	Facilitates continuous improvement cycles and personalized learning.	Scalability and sustainability remain challenges in broader implementation.

The relationship between the description and explanation of the data on Learning Analytics and the research problem is crucial. The literature shows that Learning Analytics has the potential to revolutionize education by providing real-time insights into student and teacher performance (Jiang et al., 2024). However, the challenge lies in how to integrate this powerful tool into HRM practices effectively. While many educational institutions recognize the potential of Learning Analytics, they often lack the infrastructure, expertise, and strategies to use this data to enhance HRM practices. This gap between the potential of Learning Analytics and its practical application in HRM forms the core of the research problem, highlighting the need for further investigation into how these technologies can be optimized to improve educational outcomes.

Discussion

Human Resource Management (HRM) in Education

1. HRM plays a fundamental role in shaping the success of educational institutions by ensuring that human resources align with institutional goals. Research indicates that well-executed HRM practices, such as recruitment, performance evaluation, and professional development, directly impact teacher satisfaction, student outcomes, and overall institutional performance.
2. Despite extensive research on HRM practices, the challenge lies in integrating traditional HRM methods with modern technologies such as Big Data and Learning Analytics. Many educational institutions still rely on conventional methods, which fail to fully utilize the potential of data-driven solutions to enhance HRM practices.

This gap highlights the need for a more innovative approach to managing human resources in education.

The Role of Big Data in Education

- a. Big Data has become increasingly significant in educational settings, providing schools with access to vast amounts of information from various sources, such as student performance, behavioral patterns, and learning outcomes. Studies have shown that Big Data can improve teaching practices, student engagement, and administrative decision-making by enabling institutions to gather, analyze, and apply data in real-time.
- b. However, many educational institutions struggle with the full implementation of Big Data. A lack of technical expertise and the necessary infrastructure hinders the ability of institutions to effectively harness Big Data's potential. This underutilization is a critical issue, as it prevents institutions from making informed decisions that could improve HRM practices and overall institutional performance.

Integrating Big Data with HRM Practices

- a. While the literature underscores the potential of Big Data, the real challenge lies in its integration into HRM practices. Schools have access to vast amounts of data, but without the proper tools and infrastructure to analyze and apply this data, its full potential remains untapped.
- b. The research problem lies in exploring how Big Data can be used to enhance HRM practices. By using data-driven insights to inform decisions related to teacher recruitment, performance evaluation, and professional development, educational institutions can make more informed and effective HRM decisions. However, integrating these technologies into existing HRM processes remains a complex task that requires careful planning and investment.

The Importance of Learning Analytics

- a. Learning Analytics is another vital tool in optimizing HRM in education. It focuses on the collection and analysis of data to monitor and improve learning outcomes. Learning Analytics can help personalize learning, increase student engagement, and improve academic performance by providing valuable insights into student behaviors and learning patterns.
- b. However, despite its proven effectiveness, the integration of Learning Analytics into HRM practices is still limited in many educational institutions. Although it has the potential to enhance teacher performance and contribute to better HRM decision-making, institutions often struggle with the implementation of Learning Analytics due to a lack of resources and expertise.

Integrating Learning Analytics into HRM Practices

- a. Learning Analytics can provide teachers with real-time insights into student progress, allowing them to adapt their teaching methods accordingly. Furthermore, it can help HRM departments assess the effectiveness of professional development programs and identify areas where teachers need additional support. These insights can guide recruitment, performance evaluations, and training decisions, ultimately improving HRM practices in schools.
- b. Despite its potential, the challenge lies in the integration of Learning Analytics into existing HRM frameworks. Educational institutions need to invest in infrastructure, training, and strategies to fully leverage Learning Analytics. The research problem lies in addressing how Learning Analytics can be optimally used in HRM practices to improve both teaching quality and administrative efficiency.

The Need for an Integrated Approach to HRM, Big Data, and Learning Analytics

- a. The integration of HRM, Big Data, and Learning Analytics represents a promising solution to optimizing the management of human resources in education. By using data-driven approaches, educational institutions can make more informed decisions regarding recruitment, teacher development, and retention strategies. However, achieving this integration requires overcoming several challenges, such as lack of infrastructure, technical expertise, and resistance to change within institutions.
- b. This study emphasizes the need for further research and investment in integrating these technologies into HRM practices. By addressing the barriers to adoption and exploring strategies to effectively implement Big Data and Learning Analytics, educational institutions can enhance their HRM practices, leading to better outcomes for both teachers and students.

CONCLUSION

The integration of Human Resource Management (HRM), Big Data, and Learning Analytics holds significant potential to optimize HRM practices in education. While the literature highlights the importance of effective HRM, the full potential of Big Data and Learning Analytics remains underutilized in many educational institutions due to a lack of infrastructure, expertise, and strategic implementation. The research underscores the need for a more data-driven approach to HRM, where data insights are leveraged to enhance recruitment, performance evaluation, and professional development. Overcoming the barriers to adopting these technologies is crucial, and further research is needed to develop strategies for their successful integration into HRM practices. By doing so, educational institutions can improve both teacher effectiveness and student outcomes, ultimately fostering a more dynamic and responsive educational environment.

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