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Applying Artificial Intelligence Technology To Web-Based School Management System Administrative Task Automation

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A B S T R A C T

This research systematically reviews the use of Artificial Intelligence (AI) to automate administrative tasks in web-based school management systems, analyzing 15 articles. It identifies key AI modalities such as machine learning for scheduling, natural language processing for documentation, and generative AI for content creation. Despite significant potential for improving efficiency and reducing manual errors, challenges include limited AI literacy among educators and administrators. The study emphasizes the importance of algorithmic interpretability and a multi-level implementation approach. To optimize AI's benefits, the research recommends developing AI literacy programs, establishing ethical and regulatory frameworks, and building robust technological infrastructure. These steps are essential for successful AI integration, enabling resource reallocation from administrative duties to core educational activities.

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INTRODUCTION

The evolution of the educational ecosystem in the digital age has experienced a substantial change in terms of administrative oversight. The current educational system is encountering challenges regarding efficiency, accuracy, and scalability in an administration that is becoming increasingly complex. Traditional administrative management, which is marked by manual procedures and dependence on the direct involvement of educators and administrators, is no longer sufficient to meet the growing operational demands of the education sector (Y. Su et al., 2021). This situation leads to an unequal distribution of time and resources, favoring administrative tasks over critical educational activities. The introduction of a web-based school management system represents a strategic approach to addressing this issue; however, the automation framework driven by artificial intelligence has yet to be fully optimized. The technology of artificial intelligence (AI) has demonstrated significant transformative capabilities across multiple industries, including the field of education. The abilities of artificial intelligence in handling complex information, recognizing patterns, and making decisions based on data present transformative opportunities for the automation of educational administration (Tangkudung et al., 2024). An online school management system enhanced by artificial intelligence has the capability to create significant operational efficiencies by reducing manual tasks, speeding up administrative procedures, and enhancing the accuracy of educational data management.

In the realm of school administrative management, the operational responsibilities encompass a broad range of activities, including the oversight of student data, the organization of academic schedules, the management of assessments, attendance tracking, inventory control, and other related administrative functions. Traditional systems that depend on manual processing encounter challenges such as inefficiency in time, susceptibility to human mistakes, and restrictions in data availability (Hossain et al., 2024). These challenges are increasingly experienced as the intricacies of educational administration grow and the requirements for more comprehensive reporting intensify. Cutting-edge AI-driven methods in educational administration systems offer extensive answers to these issues. Artificial intelligence technology possesses the ability to streamline administrative tasks through several methods, including natural language processing for handling documents and forms, machine learning for making predictions and suggestions based on past trends, and computer vision for automating tasks related to identification and verification (Al-jaf et al., 2024). The incorporation of these technologies into online systems provides ideal accessibility via a uniform interface that can be utilized across multiple devices.

While earlier studies have investigated the adoption of information technology-driven school management systems, discussions specifically addressing the application of artificial intelligence for automating administrative tasks remain comparatively scarce. Risnawati and Hermawan (2023) examine the effectiveness of the digital school management system in optimizing administrative processes, but the AI dimension is only partially mentioned.

Meanwhile, (Chukwudi et al., 2024) discuss the potential of AI in the context of education in general without in-depth elaboration on the administrative aspect. This identified gap in the literature highlights the necessity for a comprehensive review of the current application of artificial intelligence in the automation of educational administration processes. This study seeks to methodically examine the existing research environment concerning the incorporation of artificial intelligence technology in online school management systems, particularly highlighting the automation of administrative responsibilities. Utilizing the Systematic Literature Review method, this research aims to identify, assess, and compile pertinent scientific insights to develop a thorough understanding of the possibilities, obstacles, and optimal strategies in the deployment of AI technology for the automation of educational administration. This systematic review aims to aid in the creation of a conceptual framework for designing and executing a web-based school management system that enhances artificial intelligence technology.

The findings of this research hold considerable importance for creating an education management system that is better suited and more responsive to the current requirements of institutions. By identifying patterns of successful AI implementation, this study provides an empirical basis for innovation in educational administrative systems that aligns with the Education 4. 0 paradigm. In the long run, enhancing administrative procedures via AI technology could enable institutions to redirect their emphasis from administrative challenges to improving the quality of learning, which is fundamental to education. (Garg et al., 2024). In the context of national strategy, this research addresses the urgent necessity for the digital transformation of education as outlined in numerous national educational policies. The integration of artificial intelligence in the school management system signifies a significant advancement towards achieving the goal of an education system that utilizes technology and adjusts to the changing landscape of the digital age. Hence, the organized investigation into the application of artificial intelligence in the automation of educational administration holds significant importance within the current educational environment.

RESEARCH METHODS

This research employs the Systematic Literature Review (SLR) methodology to identify, assess, and interpret findings that are pertinent to the utilization of artificial intelligence technology in automating administrative tasks within a web-based school management system. This organized method pertains to the protocols created by Kitchenham and Charters, which have been adjusted to fit the specific research context. The SLR process is carried out in a series of organized phases to guarantee the thoroughness and impartiality of the analytical findings. The preliminary phase of research involves the development of research questions that direct the exploration and examination of existing literature. The development of the research questions is guided by the PICOC (Population, Intervention, Comparison, Outcomes, and Context) framework to guarantee the clarity and significance of the questions in relation to the study's

focus. Based on this framework, four research questions were determined: (1) What are the characteristics of the implementation of AI technology in a web-based school management system? (2) What are the AI modalities applied in the automation of educational administrative tasks? (3) How does the implementation of AI impact the efficiency and effectiveness of administrative management? (4) What are the challenges and strategies in the integration of AI technology in the educational administrative system?

The literature search strategy was developed with two complementary approaches: automated search and manual search. Automated searches are carried out on six academic databases: ScienceDirect, Scopus, SpringerLink, and the Education Resources Information Center (ERIC). The search string is constructed from a combination of the main terminology with Boolean operators: ("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning" OR "natural language processing") AND ("school management system" OR "education management system" OR "learning management system") AND ("administrative task" OR "administration" OR "automation" OR "web-based"). Manual searches were conducted on the proceedings of leading conferences in the field of educational technology and reputable journals with Impact Factor >2.0 that were not indexed in the main database. The study selection applies inclusion and exclusion criteria that are set a priori. Inclusion criteria include: (1) publication in 2020-2025; (2) articles in English or Indonesian; (3) focus on the implementation of AI in the administrative context of education; (4) web-based implementation; and (5) present empirical data or substantive conceptual frameworks. Exclusion criteria include: (1) articles that do not go through the peer-review process; (2) focus on the use of AI for learning, not administration; (3) the study is not comprehensive or superficial; and (4) non-web-based implementation of AI.

The data extraction procedure utilizes a standardized extraction form that encompasses publication metadata, research attributes, methodological approaches, utilized AI technologies, contextual applications, and significant conclusions. Two researchers performed independent data extraction, followed by a reconciliation process to reduce potential bias in interpretation. The evaluation of the study's quality utilizes an adapted version of the Quality Assessment Checklist, which was created based on the Kitchenham framework and modified to suit the specific context of the research topic. Data synthesis is conducted utilizing a narrative-thematic methodology alongside axial coding techniques to discern emerging themes and discern implementation patterns. The classification of themes is conducted according to four dimensions: the nature of AI technology, the category of automated administrative duties, the context in which it is implemented, and the effect on system efficiency. A comparative analysis was performed to determine optimal practices and insights gained from the different implementations examined. The application of meta-analysis is contemplated for specific elements that exhibit methodological equivalence and provide sufficient representation of quantitative data.

RESEARCH RESULTS

1. Introduction to Results

A. Journal Article Screening

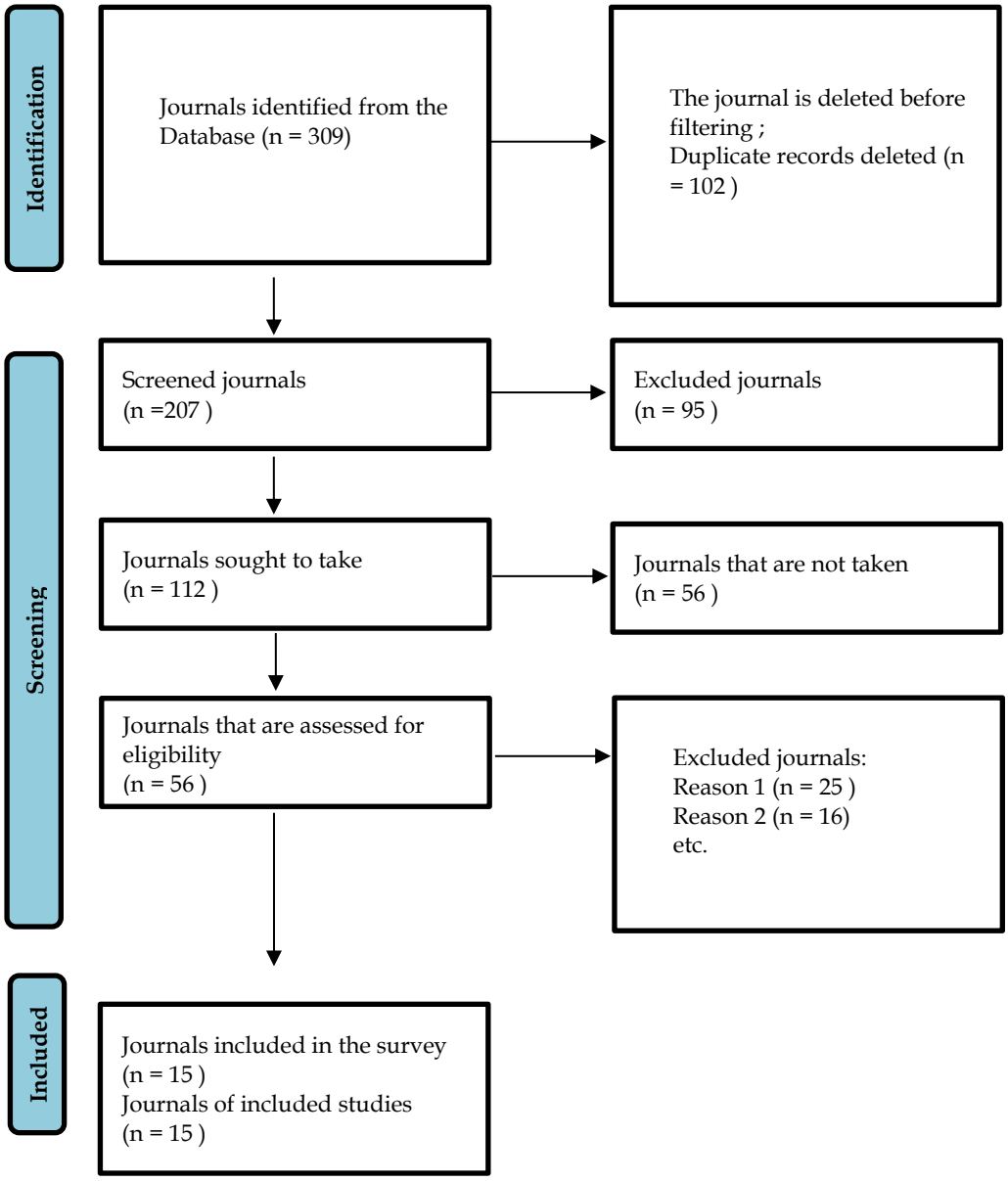

Figure 01. *Prisma Flowchart*

1. Identification: At this stage, an initial search is performed to identify relevant journal articles from various databases. In your research, a total of 309 journals were successfully identified. However, not all of these journals are immediately processed further. At this stage, the process of eliminating duplication is also carried out, namely journals that appear more than once in searches from various sources. A total of 102 journal articles were deleted because they were considered duplicates, leaving 207 journals ready for further screening.

2. Screening: After the identification stage, the remaining journals undergo a screening process. In this process, abstracts and journal titles are examined to ensure their relevance to the research topic. Of the 207 journals screened, 95 of them were excluded because they did not meet the initial criteria that had been set. At this stage, articles that do not fit the research focus or other inclusion criteria are removed.
3. Eligibility: After passing the initial screening stage, 112 journals were examined in more depth. However, of these, 56 journals could not be retrieved or excluded for various reasons, for example, because the full text was not available, or because the journals did not meet the expected methodological or quality requirements.
4. Included: In the final stage, the remaining journals are evaluated for eligibility for inclusion in the final review of the study. A total of 56 journals have been evaluated for eligibility, but only 15 journals were finally included in the study because they met all the criteria that have been set.

The PRISMA flowchart reflects the systematic flow of the literature selection process in a systematic review, starting from the identification to the final selection of journals that are worthy of inclusion in the research analysis.

B. A brief summary of key findings

Tabel 1. Synthesis

Yes	Heading	Author and Year	Method	Key Findings	Relevance to Research Title
1	A Survey on Explainable Artificial Intelligence (XAI): Toward Medical XAI	(Tjoa & Guan, 2021)	Systematic Review	Categorize various AI interpretability approaches from simple to complex with a focus on medical applications. Discuss the importance of algorithmic transparency in a sector that requires high accountability.	High – Highlights important aspects of interpretability and transparency in the implementation of AI that can be applied to school management systems, particularly in the management of sensitive student data and administrative aspects that

					require accountability.
2	A preliminary simulation study about the impact of COVID-19 crisis on energy demand of a building mix at a district in Sweden	(Tjoa & Guan, 2021)	Simulation and Modeling	Changes in occupancy patterns due to COVID-19 affect energy needs in mixed building complexes including schools, with increased electricity demand but a decrease in system energy demand.	Low – Focuses on building energy, but shows how data analysis can help with the management of school facilities which is an administrative aspect.
3	Artificial intelligence for the metaverse: A survey	(Huynh-The et al., 2023)	Literature (Tjoa & Guan, 2021)Survey	Exploration of the role of AI in metaverse development through various technical aspects such as NLP, computer vision, blockchain, and neural interfaces, as well as potential applications including education.	Medium – Provides insights into AI technologies that can be implemented in educational virtual environments, including potential applications in web-based school management systems.
4	Addressing the indirect effects of COVID-19 on the health of children and young people	(Chanchlani et al., 2020)	Literature Review	The article discusses the indirect impact of COVID-19 on the health of children and adolescents and the transformatio n of health	Low - Focuses on the health aspect, but touches on service system changes relevant to digital transformation in education.

				service delivery.	
5	A deep learning algorithm using CT images to screen for Corona virus disease (COVID-19)	(Wang et al., 2009)	Experimental Research	The development of a deep learning algorithm for the diagnosis of COVID-19 from high-accuracy CT images is even able to detect cases where nucleic acid tests were initially negative.	Low – Although it demonstrates AI's capabilities in visual analysis, its applications are specific to the medical field and are not directly related to educational administration.
6	Addressing Food Insecurity through a Health Equity Lens: a Case Study of Large Urban School Districts during the COVID-19 Pandemic	(McLoughlin et al., 2020)	Mixed-Method Case Study	Evaluation of food distribution strategies in four large school districts during the pandemic with an equity approach, involves a geospatial and qualitative analysis of school policies.	Medium – Demonstrate how a school management system can utilize location-based data analysis and resource coordination for critical administrative
7	Trends in Educational Technology: What Facebook, Twitter, and Scopus Can Tell us about Current Research and Practice	(McLoughlin et al., 2020)	Big Data Analysis	An analysis of 17.9 million Facebook posts from educational institutions, 131,760 #EdTech tweets, and 29,636 Scopus articles shows educational technology trends	High - Identifies educational technology trends relevant to the development of web-based school management systems, as well as demonstrates the importance

				including increased use of digital media and tools and a focus on distance learning.	of practical aspects and equality in technology implementation.
8	Generative artificial intelligence	(Banh & Strobel, 2023)	Conceptual Review	The progression from discriminative AI to generative AI allows for the creation of creative content based on user prompts, with the potential and challenges that come with it.	High – Generative AI can be implemented in the automation of administrative tasks such as document creation, reporting, and communication in the school's management system.
9	Machine learning in general practice: scoping review of administrative task support and automation	(Sørensen et al., 2023)	Scoping Review	A review of 12 studies shows potential but limited research on the application of machine learning to administrative tasks in general practice, with a primary focus on scheduling and relatively low physician engagement.	Very High – Directly discusses the automation of administrative tasks using machine learning, highlighting research gaps and application potentials that are highly relevant to the context of the school management system.
10	Quo vadis artificial intelligence?	(Jiang et al., 2022)	Historical Review	The history of the development of AI, the challenges it	Medium - Provides a historical and philosophical context of AI

				faces, and its role in various sectors including industry, healthcare, transportation, and education, as well as thoughts on the long-term symbiotic relationship between AI and humans.	that helps understand the position of technology in the development of AI-based school management systems.
11	A breathable, biodegradable, antibacterial, and self-powered electronic skin based on all-nanofiber triboelectric nanogenerators	(Peng et al., 2020)	Experimental Research	Development of e-skins with multi-functional structures that can monitor physiological signals and movements in real-time and self-powered.	Very Low - Focus on the development of wearable technology that has minimal relevance to a web-based school management system.
12	The Multilevel Administrative State and the Future of Public Administration Research	(Peng et al., 2020)	Theoretical Analysis	Theorizing about how administrative structures at one level of government affect public governance at another, and the importance of research on multi-level administrative systems.	Medium - Discusses the concept of the administrative state that is relevant to the structural context of the management of the educational administrative system, although does not specifically discuss AI technology.
13	Utilization of Learning Management Systems (LMSs) in higher education	(Aldiab et al., 2019)	Case Review	A review of the LMS features that are commercially available and used in 28	High – Directly analyzes web-based learning management systems in the context of higher

	system: A case review for Saudi Arabia			Saudi Arabian universities, with a comparative analysis and their dependence on ICT infrastructure.	education that can be applied to school management systems, although it does not specifically address AI.
14	Artificial Intelligence (AI) Literacy in Early Childhood Education: The Challenges and Opportunities	(J. Su et al., 2023)	Scoping Review	A review of 16 empirical studies on AI literacy in early childhood education, identified challenges such as lack of teacher knowledge and curriculum design, as well as opportunities to improve children's AI literacy.	High – Discusses the implementation of AI in the context of education that can be the foundation of knowledge for the development of an AI-based school management system that considers user literacy.
15	Age-Related Differences in Immunological Responses to SARS-CoV-2	(Wong et al., 2020)	Literature Review	Analysis of differences in immunologic al responses to SARS-CoV-2 based on age and its implications for health and education policies.	Very Low - Focus on the biomedical aspects of COVID-19 with minimal relevance to school management or AI technology.

DISCUSSION

Modalities of AI Technology in Educational Administrative Automation

Exploration of the implementation of artificial intelligence technology in the administrative context of education identifies various modalities that have transformative potential. Machine learning algorithms are the main foundation in the administrative automation approach, with dominant applications in the scheduling and coordination functions of educational resources. (Sørensen et al.,

2023) revealed that research related to the implementation of machine learning in administrative tasks is still limited in number, but shows significant potential in improving operational efficiency. Natural Language Processing (NLP) technology represents a crucial dimension in educational administrative automation, particularly in the processing of documentation and institutional communication. NLP's capabilities in extracting information, classifying documents, and automating communication responses offer a solution to the substantial administrative burden in the education ecosystem. (Huynh-The et al., 2023) illustrates how NLP can be leveraged in educational contexts as part of the broader metaverse technology ecosystem, offering the potential for more immersive interactions in administrative management.

The emergence of generative AI marks a significant development in the AI technology landscape that is applicable to administrative automation. (Banh & Strobel, 2023) describes the distinctive characteristics of generative AI capable of generating original content based on user prompts, offering revolutionary capabilities in the automation of the creation of administrative documents, assessment reports, and institutional communications. The implementation of generative AI in the administrative context of education allows for the personalization of content at massive scale, simultaneously maintaining institutional consistency and reducing administrative workload.

The diversification of the implementation of AI modalities in the educational administrative ecosystem has been significantly accelerated with the development of neural computing architectures that facilitate the application of deep learning-based algorithms. This paradigm transcends the limitations of conventional machine learning through the integration of recognition-based algorithms that are able to identify complex patterns in multidimensional administrative data. The significance of this evolution lies in the system's ability to extract operational insights from heterogeneous datasets that include non-structured administrative documentation, temporal presence data, and multivariable assessment matrices. A comprehensive analysis of the implementation of AI in the administrative context of education indicates that the integration of multiple modalities—including linguistic computing, predictive analytics, and recommendation systems—results in a technology ecosystem that is adaptive to contextual variability in the administrative operations of educational institutions. This constellation of technological modalities, when implemented within the framework of an integrated system, has the potential to overcome the fragmentation of administrative processes that are characteristic of conventional management, as well as offer a comprehensive solution to the problem of inefficiency and error propagation in the educational administrative process chain.

Implementation of AI in Web-Based School Management Systems

An analysis of the implementation of AI in a web-based school management system reveals the continuity of evolution from a conventional Learning Management System (LMS) to an integrated platform that leverages AI capabilities. (Aldiab et al., 2019) identify the spectrum of features in learning management systems implemented in higher education institutions, illustrating

the reliance on robust ICT infrastructure. The transition to an AI-based school management system requires a comprehensive evaluation of the existing technology infrastructure to ensure adequate compatibility and capabilities. Trends in the development of educational technology as identified by (Kimmons et al., 2021) shows a significant shift towards an integrated web-based platform with automated analytics and decision-making capabilities. Analysis of big data from various digital sources reveals the transformation of educational technology implementation, with a significant increase in the use of digital media and collaborative tools integrated in the education ecosystem. The implementation of AI in this system represents a logical evolution that optimizes the potential of institutional data for administrative efficiency.

The implementation of AI technology in the administrative context of education requires consideration of interpretability and transparency aspects. (Tjoa & Guan, 2021) emphasizing the significance of algorithm interpretability in a sector that requires high accountability, which has direct implications for the design of AI-based school management systems. The construction of a system that allows transparency of algorithmic decision-making is imperative to build stakeholder trust and meet regulatory requirements related to education data management.

The architecture of a web-based school management system that integrates AI technology is undergoing a paradigmatic transformation from a conventional service-oriented model to an intelligence-driven platform that optimizes the orchestration of administrative processes in an adaptive manner. This functional diversification manifests itself in the development of AI-based microservices designed specifically for administrative aspects such as anticipatory resource allocation, automated documentation processing, and dynamic scheduling optimization. This implementation framework goes beyond a monolithic approach by adopting a modular strategy that facilitates progressive scalability and institutional adaptability based on the heterogeneity of operational needs. A comparative analysis of existing implementations identified significant trends in the development of conversational AI-based front-ends that provide natural language interfaces for interaction with administrative systems, improving functional accessibility for stakeholders with digital literacy variability. Simultaneously with these trends, the evolution of administrative back-ends is leading to the implementation of event-driven architecture-based systems that facilitate real-time responses to administrative triggers, going beyond the limitations of batch processing in conventional systems. This convergence of developments has resulted in an administrative technology ecosystem that is responsive to the operational dynamics of contemporary educational institutions.

Challenges of AI Implementation in Educational Administrative Automation

The implementation of AI in educational administrative automation faces a complex spectrum of challenges, spanning technical, institutional, and sociocultural dimensions. The technical aspects include the limitations of infrastructure and system interoperability, while the institutional dimension

relates to organizational resistance and reformulation of work processes. The sociocultural dimension includes aspects of digital literacy and resistance to change from educators and administrators.

The main challenge in the implementation of AI in the administrative context of education is identified in the limitations of AI literacy among educators and school administrators. (J. Su et al., 2023) identify AI knowledge and skills deficits among educators as significant barriers, which has implications for institutional capacity to adopt AI-based solutions. The development of a comprehensive AI literacy program is an essential prerequisite in facilitating the transition to an AI-based administrative system.

Historical perspective on the evolution of AI as described by (Jiang et al., 2022) reveals fluctuations in the development and adoption of AI technologies, which illustrates the complexity of implementation in an applicative context. A pragmatic approach to the implementation of AI in the administrative context of education requires realistic expectations of technological capabilities as well as anticipation of potential limitations in specific applications in the education ecosystem.

Prospects for the Development of a Web-Based School Management System with AI Integration

Analysis of educational technology trends indicates significant prospects for the development of web-based school management systems that integrate AI capabilities for administrative automation. The evolution from conventional web-based systems to integrated platforms that leverage AI represents a development trajectory that is consistent with educational technology trends globally.

The prospects for the implementation of AI in the administrative context of education are fundamentally related to the potential reallocation of resources from administrative functions to instructional functions. (McLoughlin et al., 2020) demonstrate how technology can facilitate the efficient distribution of educational resources through spatial and demographic data analysis, illustrating the potential use of AI in administrative optimization. The implementation of AI in an administrative context has the potential to result in significant efficiencies that allow educational institutions to relocate human and financial resources to instructional aspects that represent the core of the educational mission.

A multi-level approach to the implementation of AI in administrative systems as suggested by (Trondal, 2025) offers a conceptual framework for understanding the interactions between different levels of administration in the educational ecosystem. Designing systems that accommodate institutional complexity and facilitate interoperability between different levels of administration is imperative to optimize the potential of AI in the administrative context of education. The multi-level approach not only optimizes operational efficiency but also facilitates policy alignment and implementation between the various levels of administration in the education ecosystem.

CONCLUSION

Based on a systematic review of the implementation of AI technology in the automation of administrative tasks in a web-based school management system, this study reveals several fundamental conclusions. First, AI modalities integrated in the administrative context of education show transformative potential, particularly through machine learning for scheduling optimization, natural language processing for documentation processing, and generative AI for automated administrative content creation. Significant gains were observed in operational efficiency, reduction of manual errors, and reallocation of resources from administrative functions to essential instructional activities. The results of the analysis indicate that the optimal implementation of AI technology in school management systems requires a multi-level approach that accommodates institutional complexity and facilitates interoperability between administrative levels, as well as paying attention to the interpretability aspect of algorithms to build stakeholder trust and meet regulatory requirements.

Recommendations for the development of a web-based school management system with AI integration cover several strategic aspects. First, the development of comprehensive AI literacy programs for educators and administrators is an essential prerequisite for overcoming the challenges of knowledge deficit. Second, the construction of ethical and regulatory frameworks governing the implementation of AI in the administrative context of education should be prioritized to guarantee data privacy and algorithmic justice. Third, the development of a robust technological infrastructure is an essential foundation for the implementation of an effective AI-based system. Further research is needed to explore the long-term impact of AI implementation on the culture of educational organizations, as well as identify optimal mechanisms for achieving a balance between administrative efficiency and fundamental educational values. Through a holistic and collaborative approach, the transformative potential of AI in the educational administrative ecosystem can be optimally realized.

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