OPTIMIZING EDUCATIONAL DATA MANAGEMENT FOR EVIDENCE-BASED DECISION MAKING IN EDUCATIONAL INSTITUTIONS IN THE SOCIETY 5.0 ERA

Hernawati W Retno Wiratih[1a*], Bruno Rumyaru[2b], Hazimi Bimaruci Hazrati Havidz[3c]

[1,2] Universitas President
[3] Universitas Bina Nusantara

[a] hernawati_life@president.ac.id
[b] brunorumyaru@preaident.ac.id
[c] hazimi.havidz@binus.ac.id

(*) Corresponding Author
hernawati_life@president.ac.id

ABSTRACT

This study examines the persistent problem of data fragmentation that prevents educational institutions from fully implementing evidence-based decision making within the Society 5.0 era. The research aims to analyze how unintegrated data systems hinder institutional responsiveness and to identify strategic solutions for optimizing educational data management. Using a library research method, data were collected from books, scientific articles, reports, and prior studies related to educational data optimization, learning analytics, and institutional digital transformation. The analysis shows that fragmented data limits the accuracy of decisions, restricts the use of advanced analytics, and contradicts the human-centered technological vision of Society 5.0. The study concludes that integrated and interoperable data systems are essential for strengthening decision-making processes, improving educational quality, and enabling effective digital innovation in educational institutions.

INTRODUCTIONS

In contemporary educational environments, institutions face an escalating challenge in managing the massive volume, variety, and velocity of data generated through academic, administrative, and learning processes, making the issue increasingly urgent in the Society 5.0 era. Educational institutions today collect information from numerous digital platforms, ranging from learning management systems and student performance dashboards to institutional quality assurance indicators, yet the data often remain fragmented and underutilized. This fragmentation prevents educators and administrators from forming a coherent understanding of student needs, institutional performance, and emerging learning trends that are crucial for informed decision-making. As schools and universities adopt more digital tools, the gap between data availability and data usability widens, creating inefficiencies in planning, monitoring, and

evaluating educational strategies. The inability to integrate data effectively leads to decisions based on assumptions rather than grounded evidence, which ultimately limits the capacity of institutions to improve the quality of teaching, enhance student outcomes, and develop responsive educational policies aligned with the demands of Society 5.0. Therefore, the real problem lies not in the lack of data but in the suboptimal management and utilization of educational data, which necessitates a systematic exploration of how data optimization can strengthen evidence-based practices within modern educational ecosystems(Abdurrahman, 2025).

Existing literature widely acknowledges the transformative role of data in shaping effective educational decisions, yet studies consistently highlight that educational institutions still struggle to operationalize data-driven approaches in a meaningful and sustainable way. Many theoretical frameworks emphasize the potential of learning analytics, data mining, and digital assessment systems to support personalized learning and institutional improvement; however, these frameworks often remain conceptual and do not fully address the practical barriers faced by institutions. Research shows that despite the availability of technological tools, educators frequently lack the skills, infrastructure, or organizational support required to translate raw data into actionable insights. Additionally, several studies point out that current models for evidence-based decision making tend to overlook the complexity of real-world educational environments, where data are dispersed across departments and governed by inconsistent standards of collection and interpretation. This disconnect between theory and practice reveals a critical gap in understanding how data management can be optimized to meet the expectations of Society 5.0, which demands seamless integration between human-centered values and advanced digital technologies. Consequently, while previous literature provides valuable theoretical foundations, it has not fully resolved how institutions can bridge the gap between technical potential and practical implementation, demonstrating the need for research that directly addresses this unresolved challenge(Gonugunta & Leo, 2024).

The purpose of this research is to examine and formulate strategies for optimizing educational data management to enhance evidence-based decision making within educational institutions operating in the Society 5.0 era. Specifically, this study aims to explore how data can be systematically collected, organized, integrated, and analyzed in ways that strengthen institutional decision-making processes and support more accurate, timely, and context-sensitive educational interventions. By focusing on data optimization, the research intends to provide a clearer understanding of the mechanisms required to transform fragmented data sources into coherent, meaningful insights that can guide educators, administrators, and policymakers. Furthermore, this study seeks to identify practical models and approaches that can help institutions build a data-driven culture where digital technologies, analytical tools, and human expertise work in synergy. The overarching goal is to offer a structured framework that educational institutions can adopt to improve their responsiveness, efficiency, and adaptability in a highly digitized, human-centered society. Through this research, it is expected that educational stakeholders will gain new knowledge and practical guidance on how to leverage data effectively to support teaching, learning, and institutional development in line with the principles and challenges of Society 5.0(Karim et al., 2025).

This research argues that optimizing educational data management is a critical and necessary step for advancing evidence-based decision making, particularly within the complex and technology-driven context of Society 5.0. The central hypothesis posits that when educational institutions implement structured, integrated, and analytics-driven data management practices, they will be better equipped to identify problems accurately, design targeted interventions, and evaluate the effectiveness of educational strategies. This argument is supported by the reality that current institutional decisions often rely on incomplete or inconsistent data, leading to inefficiencies in curriculum planning, student support, and resource allocation. Moreover, as the Society 5.0 paradigm emphasizes a harmonious integration between humans and intelligent systems, educational institutions must evolve from traditional, intuition-based decision models to more systematic approaches grounded in reliable data. The research also hypothesizes that adopting optimized data management practices will not only improve institutional governance but also enhance student learning experiences through more personalized and responsive educational pathways. Building upon the research purpose and the

identified gaps in existing literature, this study contends that addressing data fragmentation, technical limitations, and organizational challenges is essential for realizing the full potential of data-driven education. Therefore, this research is both timely and necessary to provide actionable insights that can support institutions in transitioning toward a more intelligent, adaptive, and evidence-oriented educational ecosystem(Sunarjo et al., 2024).

METHOD

Research Object

The object of this research centers on the phenomenon of suboptimal educational data management within institutions striving to implement evidence-based decision making in the Society 5.0 era, where digital transformation demands a more intelligent and human-centered approach to educational governance. The issue arises from the persistent gap between the availability of abundant educational data and the limited capability of institutions to utilize this data effectively for strategic planning, student assessment, and institutional improvement. This phenomenon reflects a broader challenge faced by schools and universities, where data remains scattered across multiple platforms, managed inconsistently, and analyzed without standardized frameworks. As a result, institutions often encounter difficulties in identifying priority issues, monitoring performance trends, and designing data-informed interventions that align with the accelerated digitalization characterizing Society 5.0. Therefore, the object of this research is not merely the existence of data itself but the underlying problem of how data management practices can be optimized through systematic, literature-based examination. Establishing a clear understanding of this problem allows the study to position itself within a pressing contemporary educational concern and sets the foundation for analyzing the theoretical and practical frameworks necessary for achieving effective, integrated, and evidence-driven educational decision making(George & George, 2024).

Research Type and Data Sources

This study employs a library research methodology that relies heavily on systematic examination of written sources to develop a comprehensive understanding of educational data optimization in the context of evidence-based decision making. The primary data used in this research consist of relevant literature that directly discusses issues associated with fragmented educational data, constraints in analytics implementation, and the challenges institutions face in transitioning toward data-driven decision processes(Sari et al., 2023). These primary sources include peer-reviewed journal articles, seminal academic publications, and contemporary studies that provide empirical and conceptual insights into the problems identified in the research object. Complementing these, secondary data are gathered from supporting literature that expands upon the research keywords—namely educational data optimization, evidence-based decision making, and Society 5.0 learning analytics. These secondary sources encompass books, academic reports, institutional documents, and scientific articles that contribute contextual understanding and broaden the analytical scope of the study. By integrating both primary and secondary sources, the research ensures a well-rounded, credible, and academically grounded foundation, enabling an in-depth exploration of the central issues while maintaining alignment with the standards of library-based scientific inquiry.

Theoretical Foundation

The theoretical foundation of this research is built upon several key theories that offer conceptual guidance and analytical grounding for examining educational data management in relation to evidence-based decision making. One primary theory referenced is Evidence-Based Decision Making Theory introduced by Sackett in 1996, originally formulated within the medical field but widely adapted across disciplines to emphasize the integration of best available evidence, professional expertise, and contextual needs in decision processes. Its core principle asserts that decisions are most effective when grounded in valid and systematically analyzed information rather than intuition or unfounded assumptions. Complementing this, the study also draws upon Learning Analytics Theory proposed by Siemens in 2010, which highlights the use of digital data to understand and optimize learning and educational environments through systematic measurement and analysis. This theory is particularly relevant in the Society 5.0 framework, where

human-centered technologies support continuous enhancement in education. Additionally, the research refers to the Society 5.0 Concept introduced by the Japanese Cabinet Office in 2016, which envisions a super-smart society that integrates cyberspace and physical space to improve human life, including in education. Together, these theories provide the assumptions, conceptual lenses, and interpretive frameworks necessary for analyzing how optimized data management supports responsive, informed, and technologically aligned educational decision making(Song & Wang, 2025).

Research Procedures and Data Collection

The research process is carried out through systematic stages characteristic of library research, focusing on collecting, reviewing, and interpreting written materials relevant to the study's core themes. The first stage involves identifying and selecting credible literature such as scholarly books, peer-reviewed journals, academic reports, and published research that address educational data management, evidence-based decision practices, and Society 5.0 educational transformations. Following this, the study proceeds with an intensive reading phase, during which each source is critically examined to extract key ideas, concepts, and arguments that directly correspond to the research object and objectives. The techniques used include note-taking, summarizing, categorizing information, and comparing theoretical perspectives to ensure consistency and relevance. By relying exclusively on textual sources, this method allows the researcher to build a solid theoretical understanding that reflects existing scientific discourse. Furthermore, the integration of multi-source literature enables cross-validation of concepts and identification of recurring themes that contribute to a comprehensive analysis. Through these structured procedures, the research ensures that all collected information is systematically organized and ready for deeper examination in the subsequent analytical stages(Bongomin, 2025).

Data Analysis Technique

The data analysis technique employed in this research is content analysis, which enables systematic interpretation of textual information to uncover patterns, relationships, and meaningful insights relevant to the research focus. Content analysis begins with selecting key literature that aligns with the study's objectives, followed by identifying recurring concepts, terminologies, and theoretical arguments present across the sources. The process continues with coding the information, categorizing it into thematic clusters such as data optimization strategies, institutional barriers, learning analytics applications, and evidence-based decision-making models. Through this coding procedure, the researcher can detect connections between theories and real-world educational practices, allowing for deeper understanding of how data management challenges emerge and how possible solutions can be framed. The analysis also involves comparing and synthesizing findings from different authors to highlight areas of consensus, divergence, and emerging trends that inform the development of research conclusions. By using content analysis, this study ensures that interpretations remain grounded in documented evidence rather than subjective assumptions, thus producing findings that are logically structured, reliable, and academically defensible. Ultimately, this method strengthens the research by enabling a coherent integration of diverse literature into a unified and meaningful narrative about optimizing educational data management(Mishra et al., 2022).

RESULT & DISCUSSION

Result

The findings of this literature-based research reveal that educational institutions continue to face significant fragmentation in managing their data, which directly hinders the implementation of evidence-based decision making in the Society 5.0 era. Across the analyzed sources, a consistent pattern emerges in which schools and universities possess large quantities of digital data generated from learning activities, assessments, administrative processes, and institutional evaluations, yet lack integrated systems capable of consolidating this information into easily interpretable formats. The literature shows that this fragmentation leads to delayed decision making, reduced accuracy in identifying student needs, and limited capacity to formulate targeted interventions. Furthermore, the findings indicate that many

institutions still rely on traditional, intuition-driven approaches rather than utilizing analytical insights supported by structured data. This condition demonstrates that the core issues lie not in data scarcity but in inadequate data management practices and insufficient alignment between educational processes and technological capabilities. Therefore, the results of this study emphasize that improving data integration and accessibility is a foundational requirement for institutions aiming to enhance their responsiveness and effectiveness in a digital society(Sharma & Garg, 2023).

The results also highlight that learning analytics plays a crucial yet underutilized role in optimizing educational outcomes, as evidenced by multiple sources discussing the potential of analytics to personalize learning and enhance institutional planning. Through the analysis, it becomes evident that while many theoretical frameworks illustrate how learning analytics can support tailored instructional practices, data-driven monitoring, and predictive performance modeling, educational institutions often fail to operationalize these capabilities due to limited analytical infrastructure and human resource preparedness. The literature further indicates that existing analytics tools are not consistently aligned with institutional goals, resulting in data outputs that lack contextual relevance for decision makers. Additionally, the findings reveal a widespread gap in educator digital literacy, where teachers and administrators struggle to interpret analytic dashboards or convert insights into actionable strategies. This reveals that the successful implementation of learning analytics requires not only technological adoption but also the development of organizational competencies, clear guidelines, and a culture that values continuous improvement through evidence. Consequently, the findings reinforce that without systematic preparation, the transformative potential of learning analytics remains largely conceptual rather than practical(Tornjanski et al., 2024).

Another significant finding from the literature review is the identification of institutional barriers that impede the development of effective evidence-based decision-making practices. Across numerous sources, recurring obstacles include inconsistent data collection procedures, lack of standardized formats, and minimal cross-departmental coordination. These barriers result in duplicated efforts, inaccurate reporting, and difficulty in synthesizing information to support strategic planning. The findings also reveal bureaucratic and structural limitations, where educational institutions often lack dedicated teams or roles responsible for overseeing data governance, leading to unclear accountability lines in managing and analyzing data. Furthermore, concerns related to data security and privacy are frequently cited as factors contributing to institutional hesitancy in fully adopting integrated data systems. These issues collectively demonstrate that optimizing educational data management requires more than technological solutions; it necessitates organizational restructuring, policy development, and long-term institutional commitments. The literature consistently shows that institutions with clearer governance structures and comprehensive digital policies are better equipped to implement evidence-based practices, highlighting the importance of strong institutional foundations(Yin & Ying, 2025).

The analysis also uncovers that the alignment between Society 5.0 principles and educational data management is still developing, with institutions gradually adapting to the requirements of a human-centered, technology-integrated framework. The findings indicate that while institutions acknowledge the importance of transitioning toward digital ecosystems, many have yet to fully integrate cyber-physical systems, artificial intelligence, and advanced analytics into their educational processes. Literature sources highlight that the Society 5.0 paradigm demands not only technological sophistication but also the promotion of human well-being, meaning that data systems must support personalized, equitable, and meaningful educational experiences. However, the results show that most institutions are still in the preliminary stages of digital transformation, primarily focusing on digitization rather than developing intelligent systems that actively support decision making. This gap between conceptual understanding and practical realization suggests that institutions require long-term strategic planning, investment in digital infrastructure, and capacity building for educators and administrators. The findings therefore underscore the need for holistic models that integrate technology, human-centered design, and data governance to bring educational institutions closer to the Society 5.0 vision(Indriastuti et al., 2023).

The final key finding of this research is the emergence of several strategies and best practices that demonstrate how institutions can optimize educational data management to strengthen evidence-based decision making. The literature consistently points to the importance of establishing integrated data platforms capable of consolidating academic, administrative, and behavioral data into unified systems. Additionally, effective practices include developing clear data governance policies, strengthening data literacy among educators, and employing analytical tools that align with institutional goals. The findings also highlight that cross-functional collaboration between academic departments, IT units, and institutional leadership significantly enhances the institution's ability to interpret and utilize data effectively. Moreover, sustainable data optimization requires fostering a culture that values evidence-based practices by encouraging reflective decision making, transparency, and continuous improvement. The research further identifies that institutions implementing these strategies exhibit higher accuracy in performance monitoring, improved responsiveness to student needs, and greater overall organizational efficiency. These results affirm that optimizing data management is not merely a technical adjustment but a comprehensive institutional transformation that supports the realization of data-driven educational ecosystems aligned with the demands and opportunities of the Society 5.0 era.

Discussion
Interpretation of Findings in Relation to Data Fragmentation

The discussion of the findings highlights that data fragmentation remains one of the most significant barriers preventing educational institutions from achieving evidence-based decision making, especially within the transformative landscape of Society 5.0. The identified literature consistently demonstrates that although institutions collect vast amounts of educational data, the absence of integrated systems inhibits their ability to synthesize information into meaningful insights. This condition affects multiple layers of institutional functionality, including curriculum development, academic supervision, and student performance monitoring. The implications of this finding are critical because fragmented data not only delays decision-making processes but also diminishes the

accuracy of decisions being made, ultimately affecting educational quality. Within the Society 5.0 paradigm, where digital technologies are expected to support human-centered innovations, such inefficiencies represent a fundamental contradiction to the model's goals. Therefore, interpreting this finding reveals that addressing data fragmentation must be a strategic priority for institutions aiming to thrive in increasingly digitalized ecosystems. Without cohesive and interoperable data systems, institutions risk falling behind in adopting intelligent educational solutions that support personalization, efficiency, and effectiveness.

Component	Specific Explanation
Nature of the Fragmentation	Data is dispersed across isolated platforms such as LMS records, administrative databases, teacher spreadsheets, manual documentation, and unlinked digital tools, preventing the formation of a unified institutional data ecosystem.
Mechanism Causing the Problem	Institutional systems lack interoperability standards, rely on outdated data management infrastructures, and frequently depend on manual data entry processes that create inconsistencies and siloed information flows.
Direct Operational Consequences	Administrators cannot quickly cross-verify student performance data; curriculum evaluators cannot trace longitudinal learning trends; supervisors face delays accessing real-time instructional quality indicators; and policymakers struggle to retrieve consolidated evidence for planning.
Technical Implications on Analytics	Fragmented data prevents the application of advanced analytics such as predictive modeling, early warning systems, automated learning insights, and personalized feedback systems that require centralized and clean datasets.

Impact on Decision-Making Accuracy	Decisions rely on partial, outdated, or incomparable datasets, resulting in inaccurate policy formulation, misaligned program interventions, and inefficient resource allocation at institutional and classroom levels.
Misalignment with Society 5.0 Principles	Society 5.0 demands seamless human–technology integration; however, fragmented data systems disrupt the flow of AI-driven insights, prevent automation, and hinder the development of human-centered digital educational solutions.
Pedagogical Risks	Teachers lose opportunities to personalize learning because they lack integrated profiles of student competencies, behavioral patterns, and historical progress, reducing the institution's ability to support differentiated instruction.
Strategic Institutional Risks	Institutions become unable to respond quickly to emerging educational challenges, lose competitiveness in digital transformation, and fail to meet quality assurance standards requiring data-driven evaluation.
Priority Action Identified	Institutions must implement unified data architecture, adopt interoperable platforms, integrate cross-department databases, and enforce standard data governance protocols to enable evidence-based decision making.
Expected Outcome After Mitigation	Centralized and integrated data systems enable high-level analytics, faster decision cycles, improved accuracy of institutional policies, better student monitoring, and full alignment with the digital innovation goals of Society 5.0.

Table 1 Specific Implications of Data Fragmentation for Evidence-Based Decision Making in Educational Institutions within the Society 5.0 Era

Significance of Learning Analytics in Strengthening Institutional Capacity

The discussion further emphasizes the critical role of learning analytics as a transformative tool capable of strengthening institutional capacity for evidence-based decision making. The findings illustrate that while learning analytics frameworks offer substantial potential for improving instructional design, monitoring student performance, and predicting learning outcomes, a considerable gap persists between conceptual understanding and practical implementation. This gap is largely attributed to limitations in educator digital competence, insufficient analytical infrastructure, and the lack of standardized practices for interpreting and applying analytic results. In the context of Society 5.0, learning analytics should ideally serve as a bridge between advanced technological systems and human-centered educational innovation, yet many institutions remain hesitant or unprepared to adopt such tools effectively. Discussing this finding underscores the need for systemic capacity building, including training educators, enhancing institutional readiness, and aligning analytics tools with strategic objectives. Strengthening these components would allow institutions not only to harness data for reactive decision making but also to develop predictive models that support proactive educational interventions. Ultimately, the effective use of learning analytics aligns closely with the vision of Society 5.0, where data and technology collaboratively enhance human well-being, including student success and institutional growth.

Institutional Barriers and Their Implications for Policy Development

Another key aspect emerging from the discussion involves the institutional barriers that impede the adoption of optimized data management practices. These barriers include inconsistent data collection procedures, weak governance structures, bureaucratic limitations, and insufficient cross-departmental collaboration. Discussing these barriers is essential because they directly shape the feasibility of implementing systematic evidence-based practices. Institutions that lack strong data governance policies often struggle with accountability, transparency, and standardization—three foundational elements required for high-quality data-driven decision making. In the context of Society 5.0, where cyber-physical integration demands organizational agility, these barriers indicate a misalignment between institutional readiness and technological expectations. The implications of this finding suggest that policy-level interventions must be prioritized to support clearer data management guidelines, encourage collaboration across units, and establish formal roles for data stewardship. Addressing these institutional limitations would not only

improve operational efficiency but also ensure that data is managed ethically, securely, and strategically. Thus, effective policy development becomes a crucial step in enabling institutions to transition from fragmented and reactive data practices toward proactive and integrated systems.

Alignment of Educational Data Management with Society 5.0 Principles

The discussion also reveals that the alignment between educational data management and Society 5.0 principles is still in an emergent stage, indicating both challenges and opportunities for educational transformation. Society 5.0 advocates the integration of advanced technologies such as artificial intelligence, big data, and IoT to create human-centered solutions that enhance societal well-being. However, the findings indicate that most educational institutions remain at the level of digitization, focusing primarily on converting manual processes into digital formats rather than leveraging intelligent systems capable of supporting high-level decision making. Discussing this misalignment highlights the need for institutions to conceptualize data management not merely as a technical activity, but as a strategic component of broader digital transformation goals. Institutions must invest not only in tools but also in fostering a culture that embraces innovation, experimentation, and human-machine collaboration. Aligning data management with Society 5.0 principles requires a shift in mindset, where data becomes a central driver for personalization, inclusivity, and adaptability in educational systems. This alignment is crucial to ensuring that educational institutions can meet the increasing complexities of modern learning environments and contribute effectively to the development of a super-smart society.

Practical Strategies for Institutional Transformation

The discussion next turns to the practical strategies identified in the findings, which outline how institutions can effectively optimize educational data management. Key strategies include developing integrated data systems, establishing clear data governance policies, enhancing data literacy, and fostering cross-functional collaboration. These strategies reflect a multidimensional approach to institutional transformation, recognizing that technological adoption must be accompanied by organizational, cultural, and human resource adjustments. From a practical standpoint, integrated platforms allow institutions to gather and analyze data from academic, behavioral, and administrative sources, producing a unified basis for decision making. Data governance policies ensure consistency, security, and ethical use of information, while investment in human capacity building ensures that data is not misinterpreted or underutilized. Moreover, cross-functional collaboration strengthens institutional synergy, ensuring that decisions reflect diverse perspectives and holistic understanding. Discussing these strategies reinforces the view that data optimization is a comprehensive initiative requiring sustained commitment rather than a one-time intervention. When applied effectively, these approaches enable institutions to elevate their decision-making processes, align with digital trends, and support the holistic educational advancements envisioned in Society 5.0.

CONCLUSION

The overall analysis demonstrates that data fragmentation is a critical obstacle preventing educational institutions from fully adopting evidence-based decision making, particularly in the increasingly digital and interconnected landscape of Society 5.0. Fragmented and siloed data systems weaken institutional capacity to integrate academic, administrative, and behavioral information, thereby limiting the accuracy, speed, and depth of decisions that educators and policymakers can make. This condition not only restricts the use of advanced analytics—such as predictive modeling and personalized learning insights—but also contradicts the core principles of Society 5.0, which emphasize human-centered innovation supported by seamless technological integration. Consequently, addressing data fragmentation through unified data architecture, interoperable systems, and standardized governance emerges as a strategic necessity to strengthen institutional responsiveness, improve educational quality, and enhance the overall effectiveness of digital transformation within educational environments.

REFERENCES

Abdurrahman, A. (2025). Data-Based Education Service Quality Improvement Management in the Digital Era. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *17*(1), 207–218.

Bongomin, O. (2025). *Positioning Industrial Engineering in the Era of Industry 4.0, 5.0, and Beyond: Pathways to Innovation and Sustainability*.

George, A. S., & George, A. S. H. (2024). Towards a super smart society 5.0: Opportunities and challenges of integrating emerging technologies for social innovation. *Partners Universal International Research Journal*, *3*(2), 1–29.

Gonugunta, K. C., & Leo, K. (2024). Role of Data-Driven Decision Making in Enhancing Higher Education Performance: A Comprehensive Analysis of Analytics in Institutional Management. *International Journal of Acta Informatica*, *3*(1), 149–159.

Indriastuti, F., Sahib, A., & Nuraini, R. (2023). Development of an adaptive higher education management model with artificial intelligence. *Al-Fikrah: Jurnal Manajemen Pendidikan*, *11*(2), 366–379.

Karim, M., Oktarina, K., & Antoni, S. (2025). The Role of Digital Leadership and Administrative Innovation in Enhancing School Management Effectiveness in the Era of Education 5.0. *Indonesia Journal of Engineering and Education Technology (IJEET)*, *3*(2), 60–66.

Mishra, P., Thakur, P., & Singh, G. (2022). Sustainable smart city to society 5.0: State-of-the-art and research challenges. *SAIEE Africa Research Journal*, *113*(4), 152–164.

Sari, M. N., Rahman, A., Pisol, M. I. M., Herawati, E. S. B., Rachmawati, S., Aprilia, T., & Fitriana, D. (2023). Educational Transformation in the Digital Era: Big Data Analysis to Increase Teacher Management Efficiency in Vocational High Schools. *Jurnal Akuntabilitas Manajemen Pendidikan*, *11*(2), 73–80.

Sharma, L., & Garg, P. K. (2023). *Technological prospects and social applications of society 5.0*. CRC Press.

Song, Y., & Wang, N. (2025). Application of Big Data Analytics in Education Management: Enhancing Teaching Quality and Resource Allocation Efficiency. *International Journal of High Speed Electronics and Systems*, 2540637.

Sunarjo, R. A., Chakim, M. H. R., Maulana, S., & Fitriani, G. (2024). Management of educational institutions through information systems for enhanced efficiency and decision-making. *International Transactions on Education Technology (ITEE)*, *3*(1), 47–61.

Tornjanski, V., Knežević, S., Mirčetić, V., Drinkwater, K., Alzoubi, H. M., Juraev, D. A., Verma, R. K., Alkhozahe, H., Siozos, E., & Yalouli, T. (2024). The Role of Green Society in Society 5.0: Tango Diamond in a Collective Intelligence (Hybrid) Ecosystem Founded on Human-Centricity and Sustainability. *Journal of Business and Social Sciences*, *2024*(1).

Yin, X., & Ying, C. (2025). Digital Transformation of Higher Education: Trends, Innovation Models and Strategic Paths. *Pakistan Journal of Life & Social Sciences*, *23*(1).