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Optimizing School Facilities and Infrastructure Management: A Systematic Literature Review

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Abstract: This study aims to systematically analyze previous research on the management of school facilities and infrastructure in order to identify strategies for optimizing their utilization in supporting educational processes. This study employs a Systematic Literature Review (SLR) approach by reviewing 15 relevant journal articles selected based on relevance, research design, and publication credibility. The data were analyzed using thematic analysis to identify key patterns and findings across studies. The findings reveal that effective management of school facilities and infrastructure involves several key stages, including planning, procurement, utilization, maintenance, and supervision; however, common challenges include limited financial resources, lack of systematic maintenance, and suboptimal utilization of facilities, while leadership and stakeholder involvement play a crucial role in improving management effectiveness. The novelty of this study lies in providing a comprehensive synthesis of existing literature by integrating key management components and identifying common gaps in practice, particularly in maintenance systems and resource optimization. The practical implication suggests that schools need to strengthen needs-based planning, implement structured maintenance systems, enhance supervision, and optimize the use of available resources. This study contributes to the field of educational management by offering a systematic overview of best practices and challenges in managing school facilities and infrastructure, which can serve as a reference for policymakers, school leaders, and future researchers.

Keywords: Educational Infrastructure Management, Facilities Utilization Optimization, School Facilities Management, Systematic Literature Review

A. Introduction

Influenced not only by curriculum and teaching quality but also by the availability and effective management of school facilities and infrastructure. Previous studies have shown that proper management of facilities including planning, procurement, utilization, maintenance, and supervision can significantly support the teaching and learning process. Effective infrastructure management contributes to a conducive learning environment, enhances student engagement, and improves overall

educational outcomes.

However, despite the growing recognition of its importance, several challenges remain in the implementation of facility and infrastructure management in schools. Many studies indicate that limitations in financial resources, lack of systematic maintenance, and weak supervision mechanisms often hinder optimal utilization. In addition, inconsistencies in planning and the absence of integrated management systems further reduce the effectiveness of facility use in supporting educational activities. These conditions suggest that while the concept of facility management is well understood, its practical implementation is still not fully optimized (Fitriani et al., 2025).

In terms of the current state of the art, recent research has begun to emphasize the integration of technology, leadership strategies, and stakeholder involvement in managing educational facilities. Studies highlight the importance of data-driven decision-making, digital management systems, and collaborative approaches to improve efficiency and accountability. Furthermore, the role of school leadership, particularly principals, is increasingly recognized as a key factor in ensuring that facilities are managed strategically and sustainably (Karim et al., 2025).

The novelty of this study lies in its systematic synthesis of existing literature by integrating various dimensions of facilities and infrastructure management into a comprehensive framework. Unlike previous studies that tend to focus on specific aspects or single case studies, this research provides a broader perspective by identifying common patterns, challenges, and best practices across multiple studies (Design et al., 2024). It also highlights gaps in current research, particularly in the areas of maintenance systems, optimization strategies, and the integration of management practices(Dorgham et al., 2026; Rahman et al., 2025).

The contribution of this study is to provide a structured and comprehensive understanding of how school facilities and infrastructure can be managed more effectively to support educational processes. The findings are expected to serve as a reference for school leaders, policymakers, and researchers in improving management practices and developing future studies in the field of educational management. Based on the discussion above, the research question of this study is: How can the management of school facilities and infrastructure be optimized to support effective and efficient educational processes?

B. Methods

Research Design

This study uses a Systematic Literature Review (SLR) to explore the management of school facilities and infrastructure in optimizing their utilization in educational

settings. A Systematic Literature Review (SLR) is a research method used to collect, identify, and critically analyze all relevant research studies in a structured and systematic manner. This approach allows the researcher to synthesize existing knowledge, identify research gaps, and provide comprehensive insights into the topic (Chakraborty & Kar, 2024; Sauer & Seuring, 2023).

Literature Search Strategy

The literature search was conducted using international academic databases, including Google Scholar and Scopus, by applying a combination of the following keywords:

1. "School facilities management"
2. "Educational infrastructure"
3. "Facilities utilization"
4. "School management"
5. "Infrastructure maintenance"

Inclusion criteria:
Peer-reviewed journal articles.
Publications between 2020–2025.
Studies focusing on school facilities and infrastructure management.
Exclusion criteria: 1) Non-academic articles, editorials, or reports. 2) Duplicate publications. 3) Articles not directly related to the management of school facilities and infrastructure.

PRISMA Flow Diagram

The literature selection process is visualized using a PRISMA Flow Diagram. The PRISMA 2020 flow diagram illustrates the flow of information through different stages of a systematic review, including identification, screening, eligibility, and inclusion. It shows the number of articles identified, screened, excluded, and finally included, along with the reasons for exclusion. The process consists of four main stages:

1. Identification, articles were collected from databases and additional sources.
2. Screening, articles were screened based on title and abstract, and duplicates were removed.
3. Eligibility, full-text articles were assessed for eligibility.
4. Inclusion, selected articles were included in the final review (n = 15).

Prisma Flow Diagram

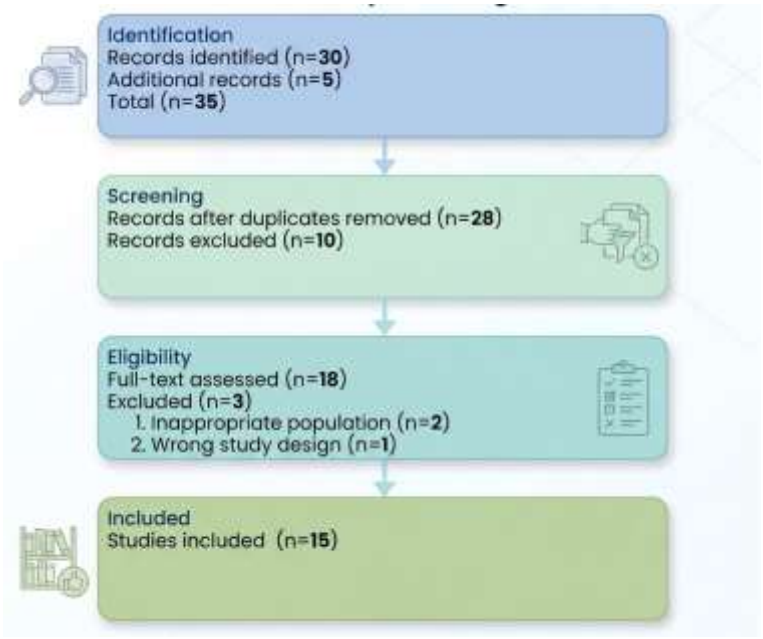

Figure 1. PRISMA Flow Diagram of Study Selection

Data Analysis

The selected articles were analyzed using thematic analysis, which aims to identify, analyze, and report patterns (themes) within the literature. This method ensures a structured and systematic interpretation of the data. The analysis process was conducted in four stages:

1. Searching for themes, grouping codes into broader and meaningful themes related to facilities and infrastructure management.
2. Reviewing themes, evaluating and refining themes to ensure consistency with the data.
3. Defining and naming themes, clearly defining each theme for better interpretation.
4. Producing the report, presenting findings in a structured narrative, highlighting patterns, challenges, and best practices in managing school facilities and infrastructure.

This approach ensures that the analysis is systematic, transparent, and reliable, and provides insights that can support the improvement of educational facility management practices.

C. Results and Discussion

The management of school facilities and infrastructure is not merely an administrative activity, but also has a significant impact on the effectiveness of the teaching and

learning process. Proper management ensures that educational resources are utilized efficiently to support learning outcomes. Previous studies emphasize that facilities and infrastructure management has long been recognized as a crucial component in educational management systems, and its role continues to evolve alongside the development of educational practices and policies(Maulana et al., 2025). Based on the analysis carried out on 15 selected journal articles that meet the established criteria, the research results are presented as follows.

Table 1. Results of the Review of Mapping Journal Article Data with Related Research

No	Journal Title	Author	Research Purposes	Method	Research Results	Key Findings
1	A Critical Analysis of Methods for Seismic Risk Assessment of Nonstructural Elements in School Buildings	(Demartino et al., 2026)	To critically analyze existing methods for assessing seismic risk of nonstructural elements in school buildings.	Literature review and comparative analysis of seismic risk assessment approaches.	The study highlights that many current methods focus mainly on structural elements and underestimate the vulnerability of nonstructural components such as ceilings, equipment, and partitions.	Nonstructural elements play a significant role in seismic risk; therefore, improved assessment models are needed to ensure safety and resilience in school buildings.
2	Educational Spaces: The Relation between School Infrastructure and Learning Outcomes	(Carrington & Andrade, 2024)	Identifying types of school infrastructure related to learning outcomes.	Analysis of ERCE-2019 data on primary schools in Ecuador.	There is a positive correlation between certain types of infrastructure and student achievement.	Infrastructure spending should be directed at facilities that have the greatest impact on learning outcomes.
3	Education Infrastructure Inequality and Academic Performance in Ghana	(Animah et al., 2024)	Assessing the relationship between educational infrastructure inequality and academic achievement.	ANOVA dan System GMM.	Infrastructure inequality is related to differences in academic achievement between regions.	The gap in school facilities increases the inequality in learning outcomes.
4	Built Environment of Basic Schools and Performance Outcomes in Rural Ghana: Learners' Voice	(Yahaya et al., 2025)	Examining how the physical environment of schools affects student performance in rural areas.	Cross-sectional; 86 schools and 949 students.	Poor infrastructure is associated with lower learning performance.	The condition of buildings, supporting facilities, and didactic equipment affect student engagement and performance.

5	Impact of Early Childhood School Intervention on Enrolment and Learning Outcomes: Evaluation of a Public Program in India	(Bhattacharya et al., 2026)	To evaluate the impact of early childhood school intervention programs on student enrolment and learning outcomes.	Quantitative approach using impact evaluation methods and statistical analysis of program data.	The study finds that early childhood interventions significantly improve school enrolment rates and learning outcomes, particularly in disadvantaged areas.	Early investment in school infrastructure and intervention programs plays a crucial role in improving access to education and student performance.
6	Towards the Development of a Systematic Approach for Sustainability Assessment of Educational Infrastructure: A System of Priority Areas and Design Quality Indicators	(Primc & Slabe-erker, 2023)	To develop a systematic framework for assessing the sustainability of educational infrastructure through priority areas and design quality indicators.	Mixed-method approach combining literature review and indicator development.	The study identifies key priority areas and proposes a structured set of sustainability indicators for evaluating educational infrastructure quality.	Sustainability assessment requires a comprehensive and systematic framework integrating environmental, functional, and social aspects of school facilities.
7	Breaking Through Boundaries with PAR – or Not? A Research Project on the Facilitation of Participatory Governance through Participatory Action Research (PAR)	(Visser & Kreemers, 2020)	To examine the effectiveness of Participatory Action Research (PAR) in facilitating participatory governance processes.	Qualitative research using participatory action research approach.	The study finds that PAR can support stakeholder involvement and collaborative decision-making, but its effectiveness depends on context, power relations, and facilitation processes.	Participatory approaches are essential in managing systems (including educational infrastructure), but require strong facilitation and stakeholder commitment to be effective.

8	Psychological Safety in Innovative Learning Environments: Planning for Inclusive Spaces	(Charteris et al., 2024)	Identifying aspects of innovative learning space design that influence psychological safety.	Case study; staff and student interviews.	Three design aspects were found to influence the sense of psychological safety, especially for students with additional needs.	Inclusive school facilities must pay attention to psychological aspects, not just spatial flexibility.
9	Thriving in Vertical Schools: Aspirations for Inclusion and Capability from a Salutogenic Design Perspective	(Willis et al., 2025)	To explore how vertical school design can support inclusion, wellbeing, and student capability through a salutogenic design perspective.	Qualitative study using case study approach and stakeholder analysis.	The study finds that vertical school designs can enhance student wellbeing and inclusivity when supported by thoughtful spatial planning and design strategies.	School infrastructure design plays a crucial role in promoting inclusion, wellbeing, and learning effectiveness through holistic and human-centered approaches.
10	The Impact of 5G Technologies and Technological and Environmental Factors on Educational Performance in Jordanian High Schools: The Role of Parental and Community Support in Enhancing E-Learning Experience	(Ayasrah et al., 2025)	To examine the impact of 5G technology and environmental factors on students' educational performance, and the role of parental and community support in enhancing e-learning.	Quantitative research using survey method and statistical analysis (SEM/PLS).	The study finds that 5G technology significantly improves e-learning effectiveness, while parental and community support strengthen student engagement and performance.	Advanced technological infrastructure, combined with social support, plays a crucial role in enhancing learning outcomes and educational performance.

11	Perception of Wellbeing in Educational Spaces	(Agg, 2021)	To explore how students and users perceive wellbeing in educational spaces and how physical environments influence their experiences.	Qualitative study using surveys and spatial analysis of educational environments.	The study finds that factors such as lighting, space design, comfort, and environmental quality significantly influence users' perception of wellbeing.	Educational spaces that are well-designed and comfortable contribute positively to student wellbeing, engagement, and learning effectiveness.
12	Validating Elements of Organizational Maintenance Policy for Maintenance Management of Public Buildings in Nigeria	(Ogunbayo et al., 2026)	To validate key elements of organizational maintenance policies for effective maintenance management of public buildings.	Quantitative research using survey method and statistical validation (factor analysis).	The study identifies and validates critical components of maintenance policy, including planning, funding, monitoring, and stakeholder involvement.	Effective maintenance management requires structured policies, clear procedures, and organizational commitment to ensure sustainability of public facilities.
13	Water, Sanitation, and Hygiene Facilities: Enabling or Impeding Handwashing? An Assessment of a Primary School Infrastructure in Palwal, India	(Anand, 2023)	To assess whether water, sanitation, and hygiene (WASH) facilities in primary schools support or hinder proper handwashing practices.	Case study using observation and assessment of school infrastructure conditions	The study finds that inadequate WASH facilities, such as lack of clean water and poor sanitation infrastructure, significantly hinder proper hygiene practices among students.	The availability and quality of basic infrastructure such as water and sanitation are critical in supporting health, hygiene behavior, and a conducive learning environment in schools.
14	Positive Effects of Indoor Environmental Conditions on	(Brink et al., 2023)	To examine the impact of indoor environmental conditions on	Experimental study using between-groups design.	The study finds that improved indoor environmental conditions, such as better air quality and thermal comfort,	Indoor environmental quality has a direct and measurable impact on student academic

	Students and Their Performance in Higher Education Classrooms: A Between-Groups Experiment		student performance in classroom settings.		lead to significantly higher student performance.	performance and learning effectiveness.
15	Classrooms' Indoor Environmental Conditions Affecting the Academic Achievement of Students and Teachers in Higher Education: A Systematic Literature Review	(Brink et al., 2021)	To examine how classroom physical environments influence student learning and academic achievement.	Systematic literature review.	The study finds that indoor environmental quality (lighting, air quality, temperature, and acoustics) significantly affects learning quality and short-term academic performance.	Physical classroom environments play an important role in supporting student learning outcomes, although their impact may vary depending on learning tasks and conditions.

The literature review shows that the management of school facilities and infrastructure plays a crucial role in supporting the effectiveness of the teaching and learning process, as well as improving the overall quality of education. Facilities and infrastructure are not merely physical components, but they function as strategic resources that directly influence student engagement, learning outcomes, and school performance. Effective management requires an integrated approach that includes planning, procurement, utilization, maintenance, and supervision (Animah et al., 2024; Carrington & Andrade, 2024; Yahaya et al., 2025).

From a planning perspective, studies indicate that needs-based and participatory planning is essential in ensuring that school facilities align with educational goals. Involving stakeholders such as principals, teachers, and administrative staff allows schools to identify priority needs more accurately and improve decision-making processes. Participatory approaches are also found to enhance governance and management effectiveness, although their success depends on contextual factors such as stakeholder commitment and institutional capacity (Primc & Slabe-erker, 2023; Visser & Kreemers, 2020). However, financial constraints remain a major challenge, limiting the implementation of planned programs and requiring schools to prioritize essential facilities.

In terms of infrastructure availability, the literature demonstrates that adequate school facilities significantly influence both access to education and student performance. Schools with better infrastructure tend to provide more conducive learning environments and achieve higher levels of student engagement and academic achievement (Animah et al., 2024; Carrington & Andrade, 2024). However, some findings suggest that infrastructure alone is not sufficient to guarantee improved performance, as other factors such as teaching quality, socio-economic conditions, and policy support also play important roles. This indicates that infrastructure should be understood as part of a broader educational ecosystem.

Furthermore, the utilization of facilities is a key factor in determining their effectiveness. The findings suggest that both physical and technological infrastructures must be actively used to support learning activities. The integration of technology, such as digital learning systems and internet-based platforms, enhances the flexibility and effectiveness of education (Ayasrah et al., 2025). In addition, leadership plays a critical role in encouraging teachers to utilize technology in more meaningful and innovative ways. However, the availability of technology does not automatically lead to its effective use, as it depends on teachers' competencies and training, highlighting a gap between provision and utilization.

From a maintenance perspective, the literature reveals that many schools still lack structured and preventive maintenance systems. As a result, facilities often deteriorate more quickly and cannot be used optimally over time. Effective maintenance management requires clear policies, regular monitoring, and organizational

commitment (Ogunbayo et al., 2026). In addition, the neglect of nonstructural elements in school buildings can increase risks and reduce overall infrastructure resilience (Demartino et al., 2026). Despite this, many institutions still rely on reactive maintenance approaches, indicating a mismatch between theoretical recommendations and actual practices.

In addition, the design and quality of educational spaces were found to significantly influence student wellbeing and learning experiences. Elements such as lighting, ventilation, layout, and spatial organization contribute to creating a comfortable and supportive learning environment. Well-designed educational spaces enhance both academic performance and students' psychological wellbeing (Agg, 2021; Willis et al., 2025). Furthermore, the concept of psychological safety highlights the importance of inclusive and human-centered design in educational environments (Charteris et al., 2024). However, design improvements alone may not be sufficient if they are not supported by effective teaching practices and institutional policies. However, some studies indicate that improvements in physical learning environments do not always lead to significant increases in academic performance, as the outcomes are highly dependent on teaching strategies, student characteristics, and contextual conditions (Brink et al., 2021). This suggests that infrastructure quality alone is insufficient without the support of effective pedagogical practices and institutional policies.

Moreover, leadership plays a critical role in optimizing the management and utilization of school facilities. Transformational leadership and stakeholder involvement play an important role in optimizing the use of both physical and technological resources and in encouraging innovation in educational practices (Ayasrah et al., 2025; Visser & Kreemers, 2020). Nevertheless, the effectiveness of leadership varies depending on organizational context, available resources, and institutional capacity, indicating that leadership must be supported by systemic and structural factors.

The literature review also highlights the increasing importance of sustainability and technological integration in managing educational infrastructure. Sustainable design frameworks and quality indicators are essential for ensuring long-term effectiveness and resilience of school facilities (Primc & Slabe-erker, 2023). In addition, digital technologies contribute to improving efficiency, transparency, and decision-making processes. However, challenges such as unequal access to technology, limited infrastructure, and low digital literacy continue to hinder the full implementation of these innovations.

Thus, the results of the literature review confirm that while many studies support the importance of effective management of school facilities and infrastructure, there are still gaps between theoretical frameworks and practical implementation. Effective management requires not only appropriate strategies but also contextual, strong

leadership, and continuous evaluation to ensure that facilities and infrastructure can be utilized optimally in supporting educational quality.

In addition to the previously discussed aspects, the literature also highlights the importance of integrating a holistic management approach that connects physical infrastructure, human resources, and institutional policies. School facilities and infrastructure should not be managed in isolation, but rather as part of a broader educational system that supports teaching and learning processes. The interdependence between infrastructure and pedagogical practices indicates that improvements in physical facilities must be accompanied by parallel developments in instructional strategies and institutional management. This reinforces the idea that infrastructure management is multidimensional and requires coordination among various stakeholders within the education system.

Another important finding from the reviewed studies is the role of environmental quality in shaping students' cognitive performance and concentration levels. Several studies emphasize that factors such as air quality, temperature, and acoustics significantly influence students' ability to focus and process information effectively. Poor environmental conditions may lead to discomfort, reduced attention span, and lower academic performance, whereas well-maintained and properly designed environments can enhance learning efficiency and student productivity (Brink et al., 2023). This finding suggests that school administrators should pay closer attention to environmental standards as part of infrastructure management strategies.

Furthermore, the literature indicates that equity in the distribution of school facilities remains a critical issue, particularly in developing regions. Infrastructure inequality creates disparities in learning opportunities and outcomes, as students in under-resourced schools often face limitations in accessing quality educational environments. This inequality not only affects academic performance but also impacts students' motivation and long-term educational prospects (Animah et al., 2024; Yahaya et al., 2025). Therefore, addressing infrastructure disparities should be a priority for policymakers to ensure equal access to quality education for all students.

The concept of sustainability also emerges as a significant theme in recent studies on educational infrastructure management. Sustainable infrastructure does not only focus on environmental aspects but also considers long-term usability, cost efficiency, and social impact. The implementation of sustainability principles in school facilities includes the use of energy-efficient systems, environmentally friendly materials, and adaptive design strategies that can accommodate future educational needs. These approaches contribute to reducing operational costs while improving the quality and resilience of educational environments (Primc & Slabe-erker, 2023). However, the adoption of sustainable practices often requires significant initial investment and strong policy support, which may not be readily available in all contexts.

In addition, the integration of digital technology into school infrastructure management has become increasingly important in the modern educational landscape. Digital tools and systems enable more efficient monitoring, maintenance, and utilization of facilities. For example, the use of smart systems can help track facility usage, identify maintenance needs, and support data-driven decision-making. Moreover, digital infrastructure plays a crucial role in supporting e-learning and hybrid learning models, which have become more prominent in recent years (Ayasrah et al., 2025). Despite these advantages, challenges such as limited access to technology, inadequate training, and digital literacy gaps continue to hinder effective implementation.

Another key aspect highlighted in the literature is the importance of user-centered design in educational facilities. School infrastructure should be designed with consideration for the needs and experiences of its users, including students, teachers, and staff. This includes not only physical comfort but also accessibility, inclusivity, and flexibility of learning spaces. Educational environments that are designed with a user-centered approach tend to promote better engagement, collaboration, and overall learning satisfaction (Agg, 2021; Charteris et al., 2024). This finding underscores the need for a shift from traditional infrastructure design towards more adaptive and inclusive models.

Moreover, stakeholder collaboration is identified as a critical factor in ensuring the effectiveness of school facilities management. Collaboration among school leaders, teachers, students, parents, and policymakers enables a more comprehensive understanding of needs and challenges. Participatory approaches, such as those highlighted in participatory action research, can enhance transparency, accountability, and shared responsibility in managing school resources (Visser & Kreemers, 2020). However, successful collaboration requires clear communication, mutual trust, and strong leadership to coordinate efforts effectively.

The findings also suggest that policy frameworks play a significant role in shaping the effectiveness of infrastructure management. Clear policies and guidelines provide a foundation for planning, implementation, and evaluation processes. In contrast, the absence of well-defined policies can lead to inconsistencies, inefficiencies, and lack of accountability in managing school facilities. Therefore, governments and educational authorities must develop and enforce policies that support sustainable and effective infrastructure management practices (Ogunbayo et al., 2026).

In the context of risk management, the literature highlights the importance of ensuring safety and resilience in school infrastructure. This includes not only structural safety but also the management of nonstructural elements that may pose risks during emergencies. Failure to address these aspects can compromise the safety of students and staff, particularly in disaster-prone areas (Demartino et al., 2026). This finding

emphasizes the need for comprehensive risk assessment and mitigation strategies as part of infrastructure management.

Finally, the overall synthesis of the literature indicates that optimizing school facilities and infrastructure management requires a balanced integration of multiple dimensions, including technical, managerial, social, and environmental aspects. While many studies provide strong evidence supporting the importance of infrastructure in education, there are still gaps in implementation that need to be addressed. These gaps highlight the need for continuous evaluation, adaptation, and innovation in managing educational facilities to meet evolving educational demands.

D. Conclusions

This study finds that effective management of school facilities and infrastructure plays a crucial role in improving learning outcomes, student wellbeing, and overall educational quality. Key aspects such as planning, utilization, maintenance, leadership, and technology integration must be managed in a systematic and integrated manner to achieve optimal results. In addition, the findings highlight that the quality of educational environments, including physical and digital infrastructure, significantly influences student engagement and teaching effectiveness. The practical implications of this study suggest that schools should strengthen needs-based planning, implement structured maintenance systems, enhance leadership capacity, and optimize technological support to maximize the use of available facilities. Furthermore, policymakers are encouraged to provide adequate funding and promote equitable distribution of infrastructure across schools. For future research, it is recommended to conduct empirical studies in diverse educational contexts to further examine the effectiveness of facility management strategies and explore the integration of sustainable and digital infrastructure in supporting long-term educational development.

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