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Comprehensive Management of Educational Facilities and Infrastructure to Enhance Learning Quality in Public Elementary Schools

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Abstract. The management of educational facilities is widely held to support learning quality in elementary schools, yet the evidence usually rests on physical availability rather than on the managerial cycle as a whole. This study analyzes the comprehensive management of educational facilities and its relation to the quality of the learning process at two public elementary schools: SD Negeri Gunungkembang in Cianjur Regency and SD Negeri Warungcaringin in Bandung Regency. A qualitative multiple-case study involved 22 participants (2 principals, 2 facilities officers, 8 teachers, and 10 students), 14 observation sessions, and 38 documents, analyzed with ATLAS.ti. Learning quality is operationalized through five indicators of process quality drawn from the national process standard and the engagement literature; no achievement data, test scores, or before-and-after measurements were collected. Each of the six management stages, namely planning, procurement, inventory, utilization, maintenance, and evaluation, was rated against a three-level criterion of systemic integration. Gunungkembang reaches the systemic level on four stages and Warungcaringin on none, with both remaining at the documented level elsewhere. The decisive difference is whether evaluation output demonstrably re-enters planning, while both schools share a structural weakness: inventory ledgers are not cross-referenced to maintenance logs. Where facilities were managed through a closed cycle, the process-quality indicators were observed to be present; this is reported as an observed association, not a demonstrated causal effect. Closing the loop requires documentary continuity rather than additional funding.

Keywords: Educational Facilities Management, Educational Infrastructure, Elementary School, Learning Quality.

1 Introduction

The quality of learning in elementary schools is fundamental to achieving national educational goals, since it forms the basis of students' cognitive, affective and psychomotor development. Under the demands of twenty-first-century competencies and the implementation of the Merdeka Curriculum, the learning environment has become correspondingly more important, and one of the decisive factors is the

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availability, adequacy and systematic management of educational facilities and infrastructure. Facilities managed effectively are not passive physical supports for instruction; they contribute actively to a learning ecosystem that is safe, comfortable and conducive to student development [1].

In practice, the management of facilities comprises a continuous series of managerial activities: needs-based planning, strategic procurement, inventory and administrative recording, utilization integrated into pedagogy, preventive and corrective maintenance, and systematic evaluation [1]. This cycle must run systematically and sustainably if physical assets are to align with pedagogical objectives. Field realities frequently diverge from it. Public elementary schools face chronic budget limitations, procurement occasionally disconnected from instructional needs, sub-optimal use of available physical and technological resources, and inventory administration that remains manual and disorganized. Disparities in resources and geography between rural and semi-urban schools further shape the quality of facility management and, through it, the quality of learning [2].

Prior research has consistently reported a positive association between the availability of educational facilities and the quality of learning. Adequate facilities, from well-ventilated classrooms to appropriate teaching aids and digital media, have been linked to student motivation, active participation and the effectiveness of teaching [3], [4]. A critical reading of this literature nevertheless shows that most studies evaluate the physical availability of facilities, or quantify their relation to standardized test scores, and that comprehensive qualitative inquiries into the whole management cycle, from planning through to evaluation, remain scarce in the context of Indonesian public elementary schools.

This gap calls for closer investigation of how the management of facilities is executed as a unified system, and of how that process relates to the quality of learning. A comparative study of schools with differing resource conditions offers the contextualized understanding such an inquiry requires. The theoretical framework is Ludwig von Bertalanffy's General System Theory, which treats organizations as integrated systems of interconnected subsystems [5]. On this view facility management is an interdependent cycle in which planning is the input, procurement and inventory the throughput, utilization and maintenance the operational mechanisms, and evaluation the feedback loop on which continuous improvement depends. Fig. 1 maps the six stages onto this frame.

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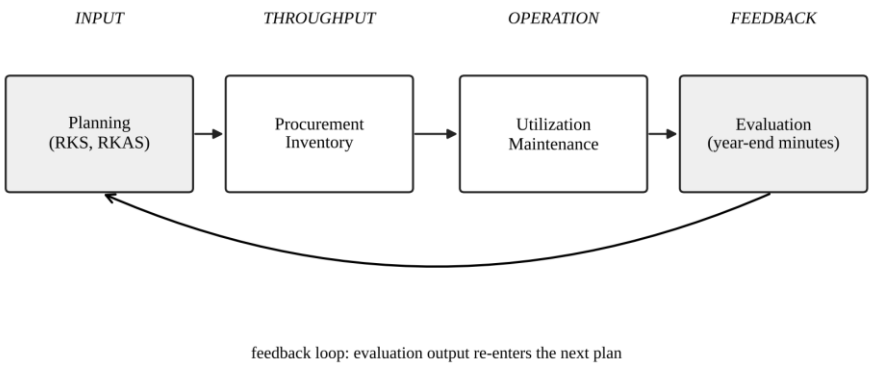


Fig. 1. The six-stage cycle of facility management read as a system: planning as input, procurement and inventory as throughput, utilization and maintenance as operation, and evaluation as feedback.

The research question is therefore how the comprehensive management of educational facilities and infrastructure is implemented in public elementary schools, and how those managerial processes relate to the quality of learning. The study analyzes planning, procurement, inventory, utilization, maintenance and evaluation, and the part each plays in that relation. Its novelty lies in the holistic systemic approach, in the use of ATLAS.ti for traceable qualitative analysis, and in the comparative lens applied to two public elementary schools with contrasting resources. By connecting educational management with contemporary leadership strategies [6], [7] and organizational resilience [8], the study offers both an empirical contribution to the literature on educational administration and practical recommendations for school leaders working with limited resources.

2 Methods

2.1 Research Design and Case Boundaries

This study employed a qualitative research approach utilizing a multiple-case study design. The qualitative paradigm was deliberately chosen as it allows the researchers to attain a profound, comprehensive, and contextualized understanding of the complex managerial processes involved in handling educational facilities and infrastructure, as well as their intricate contributions to the quality of learning. The case study method facilitates the holistic examination of these phenomena within their natural, real-world school environments, thereby capturing the authentic dynamics, challenges, and strategies employed by educational practitioners.

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The case is bounded as the management of educational facilities and infrastructure within one academic year at two schools, and the design is comparative rather than experimental. Consistent with multiple-case logic, the study is organized around an analytical proposition rather than a hypothesis: that the contribution of facility management to learning quality depends less on the volume of facilities available than on whether the six stages of the management cycle close into a functioning feedback loop. The proposition directs data collection and remains open to qualification by the evidence; it carries no claim of causal effect, since the design includes no baseline, no control school and no before-and-after measurement [9]. The unit of analysis is the managerial practice of the school, not the individual student or classroom.

2.2 Research Sites, Participants and Data Corpus

The two sites were selected purposively to contrast resource conditions while holding constant the level of schooling, the policy environment and the curriculum. Because they differ in more than their facilities, Table 1 documents their profiles alongside the participants and the data corpus, so that a reader can weigh alternative explanations for any difference reported later. Facility provision is expressed against the national facilities standard [10], which supplies a benchmark independent of either school's self-assessment.

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Table 1. Research sites, participants, and data corpus, academic year 2025/2026

Item	SD Negeri Gunungkembang (Cianjur)	SD Negeri Warungcaringin (Bandung Regency)
Setting / enrollment / classes	Rural / 186 students / 6 classes	Rural / 124 students / 6 classes
Teaching staff / accreditation	9 teachers (6 class, 3 subject) / B	8 teachers (6 class, 2 subject) / B
Principal's tenure at the school	5 years	2 years
Annual BOS allocation (approximate)	Rp 167 million	Rp 112 million
Fulfilment of the national facilities standard	Approx. 68 percent; dedicated library room, no computer laboratory	Approx. 54 percent; reading corners only, no library room, no computer laboratory
Principal	1 (KS1)	1 (KS2)
Facilities officer (PJ sarana prasarana)	1 (PS1)	1 (PS2)
Teachers interviewed	4 (GR1–GR4)	4 (GR5–GR8)
Students in focus group	5 (SW1–SW5)	5 (SW6–SW10)
Participants, total	11	11 (22 overall)
Observation sessions	7 (90–120 min each)	7 (90–120 min each)
Documents analyzed	20: RKS (1), RKAS (2), inventory ledgers (4), maintenance logs (3), lesson plans (6), evaluation minutes (3), condition reports (1)	18: RKS (1), RKAS (2), inventory ledgers (3), maintenance logs (2), lesson plans (6), evaluation minutes (3), condition reports (1)

Informants were selected on the criterion of direct responsibility for, or direct daily exposure to, the management and use of school facilities. Principals were included as holders of budget and policy authority; facilities officers as the staff who maintain the inventory and maintenance records; teachers as class teachers of grades IV to VI who had been in post for at least two years and who are the principal end-users of instructional facilities; and students from grades IV to VI with at least two years at the school, varied in sex and academic profile on the class teacher's recommendation, participating with written parental consent. Purposive selection on these criteria follows standard qualitative sampling logic for case-based designs [11].

Information adequacy was judged at the level of analytical categories rather than by a target number of informants. Codes were tracked cumulatively in ATLAS.ti as transcripts were analyzed: no new code appeared under any of the six management stages after the eighth adult interview, and the interviews conducted subsequently were confirmatory rather than generative. The student focus groups introduced no managerial sub-theme that adult accounts or documents had not already raised, although they supplied the students' own formulation of how facilities are used in

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lessons. Saturation is therefore claimed for the managerial categories that frame this study, and explicitly not claimed for the full range of student experience, which two focus groups cannot exhaust.

2.3 Operational Definition of Learning Quality

Learning quality is the outcome named in the title, and it requires an explicit definition if the study is not to claim more than it can show. This study did not collect achievement data, test scores, or any before-and-after measurement, and it therefore makes no claim about learning outcomes. What it examines is the quality of the learning process, defined by the national process standard, Permendikbudristek No. 16 of 2022, which replaced Permendikbud No. 22 of 2016 and specifies the planning, implementation and assessment of learning and the conditions under which it is to be conducted [12]. Five indicators were specified in advance, four from that standard and one from the behavioral dimension of school engagement [13].

The first indicator is instructional planning that names facilities: lesson plans specify the media, teaching aids or spatial arrangement a lesson will use, rather than leaving facility use incidental; the evidence is documentary. The second is enacted use: in an observed lesson, the available media or facilities are used for a learning task rather than displayed, which was recorded as a simple present-or-absent judgment for each observed lesson segment. The third is the physical condition of the learning space, assessed against the process standard's requirements for lighting, ventilation, seating and class size, from observation and the inventory records. The fourth is behavioral engagement during facility-based tasks, recorded in field notes as pupils visibly on task, participating or handling materials. The fifth is the functioning of the evaluation-to-planning loop, evidenced when a facility problem identified in an end-of-year evaluation can be traced into the following year's work plan or budget.

Two consequences follow for the wording of this article. No statement asserts that learning outcomes improved, since nothing in the data could establish that. What the indicators support is the presence of process-quality conditions in settings where particular managerial practices are in place, which is an observed association within each case rather than an effect attributable to the management.

2.4 Criteria for the Cross-Case Comparison

To make the cross-case comparison auditable, a criterion was specified in advance and applied identically to both schools at each of the six stages. Because the study's theoretical frame treats facility management as a system in which evaluation is the feedback loop, the criterion is the degree of systemic integration a stage has reached. Three levels are distinguished. A stage is emerging when it demonstrably occurs but leaves no record in the instrument prescribed for it. It is documented when it is carried out and recorded in that instrument. It is systemic when it is documented and its output can be traced into the stage that follows it in the cycle, so that the loop closes. These are qualitative judgments grounded in documentary and triangulated evidence, not

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measurement scores, and they rank the two cases against the criterion and against each other, not against any wider population of schools.

2.5 Data Analysis and the Coding Framework

Analysis followed the interactive model of data reduction, data display and conclusion drawing with verification [14], operationalized in ATLAS.ti. Coding proceeded in two movements. The first was deductive: the six stages of the management cycle were established as a priori code groups, and the three-level criterion of subsection 2.4 was applied as a classification filter to every coded segment. The second was inductive: material that the start list did not accommodate was open-coded and clustered into sub-themes, which were then either located within a stage or retained as cross-cutting. Network views in ATLAS.ti were used to build the cross-case display from which Table 2 is derived. Both authors coded a common subset of four transcripts independently and reconciled their code definitions by discussion before dividing the remaining material; the project file, with its code list and definitions, forms part of the audit trail.

The inductive movement produced three sub-themes that the stage-based start list had not anticipated and that are reported in the Results: the dependence of the whole cycle on a single staff member where no facilities officer is formally appointed; the use of the manual ledger as a working document rather than an archival one, which affects what can be traced; and the treatment of student duty rosters as part of maintenance rather than as pastoral routine.

2.6 Rival Explanations, Trustworthiness and Research Ethics

The two schools differ in principal's tenure, staffing, enrollment, budget and accreditation, as Table 1 records, and any of these could account for a difference in managerial practice or in the process-quality indicators. The study cannot control for them statistically and does not claim to; it documents them and applies the logic of rival explanations, in which each plausible alternative account is stated and tested against the evidence rather than left implicit [9]. The difference in principal's tenure is the most consequential: a principal in a fifth year has completed four full planning cycles, which is itself a sufficient explanation for a more closed feedback loop, and the Results say so where the two accounts cannot be separated. Consequently the study reports within-case associations between a managerial practice and the observed indicators at the school where that practice occurs, and does not attribute any difference in process quality between the two schools to a difference in their facility management alone.

Credibility rests on source triangulation across principals, facilities officers, teachers, students and documents, on technique triangulation between interview, observation and documentation, and on member checking in which the twelve adult participants were invited to contest the draft interpretation. Transferability is supported by the thick description in Table 1. Dependability rests on an audit trail of field notes, transcripts, the ATLAS.ti project file with its code definitions, the document log and analytic memos. Confirmability was addressed through a reflexive memo recording the

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authors' prior expectation that the better-resourced school would manage better, which the evidence only partly bore out.

Because the study involves minors, institutional permission was obtained from the postgraduate program of Universitas Islam Nusantara and, in writing, from both principals. Adult participants gave written informed consent covering purpose, procedure, recording, publication and the right to withdraw without consequence. Written parental consent was obtained before any student data were collected, and age-appropriate verbal assent was sought from each student and restated at the start of each focus group. Participants are referred to by the codes given in Table 1, and the consent register is held separately from the data. Focus groups were conducted in open school rooms during school hours with a teacher within sight, no researcher was alone with an individual student, and no video recording or photograph identifying a student was made for research purposes. Observation was non-participant and took place during regularly scheduled lessons, so that no additional activity was created for the research.

3 Results

3.1 Planning and Procurement of Facilities and Infrastructure

The findings of this research indicate that the initial phases of facility management—namely planning and procurement—are executed systematically, though they are heavily contingent upon the specific financial and administrative realities of each school. At both SD Negeri Gunungkembang and SD Negeri Warungcaringin, the planning of educational facilities and infrastructure is formalized through the formulation of the School Work Plan (Rencana Kerja Sekolah - RKS) and the School Activity and Budget Plan (Rencana Kegiatan dan Anggaran Sekolah - RKAS). This process is inherently participatory, involving a committee comprised of the school principal, teaching staff, and representatives from the school committee.

The core philosophy driving the planning stage at both institutions is "needs-based instructional alignment." The Principal of SD Negeri Gunungkembang explicitly stated during an interview, "Our planning for facilities and infrastructure is strictly tailored to the learning needs within the classroom, prioritizing items that directly support active student engagement and the implementation of the curriculum." Documentary analysis of the RKAS at both schools corroborates this statement, revealing that a significant portion of the proposed budget is allocated toward instructional media, classroom furniture repair, and basic pedagogical tools, rather than administrative luxuries. This participatory planning approach ensures that the voices of the teachers—who are the primary end-users of these facilities—are heard, integrating principles of transformative educational leadership where stakeholders collaborate to address 21st-century learning needs [15], [16].

Following the planning phase, the procurement of facilities and infrastructure is executed based on the finalized RKAS. The primary financial engine driving procurement at both public schools is the national School Operational Assistance (Bantuan Operasional Sekolah - BOS) fund. Due to the inherent limitations and strict

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regulatory guidelines governing BOS funds, procurement cannot be instantaneous or exhaustive; it is conducted in calculated, prioritized phases. SD Negeri Gunungkembang demonstrated a highly structured procurement timeline, categorizing needs into short-term (consumables, teaching aids) and long-term (structural repairs, technology upgrades) priorities.

A classroom teacher at SD Negeri Warungcaringin highlighted the direct impact of this targeted procurement: "The teaching aids and learning media that the school recently procured have been immensely helpful. They allow us to deliver complex materials in a way that is much easier for the students to grasp visually and interactively." Observations at both sites confirmed that recently procured items, such as anatomical models for science classes and geographic maps, were prominently displayed and actively integrated into daily lesson plans. However, both schools reported significant challenges in procuring high-cost technological infrastructure, such as interactive smartboards or adequate computer laboratories, relying instead on incremental deep-learning-based planning models to slowly integrate technology as funds permit [17].

Measured against the criterion of subsection 2.4, planning reaches the systemic level at SD Negeri Gunungkembang and the documented level at SD Negeri Warungcaringin. Both schools produce an RKS and an RKAS, which satisfies the documented level at each. The difference lies in traceability: at Gunungkembang, three of the four facility items identified as deficient in the previous year's evaluation minutes reappear by name in the following year's RKAS, so the loop can be shown to close, whereas at Warungcaringin the evaluation minutes record the deficiencies but the subsequent RKAS does not refer to them, and procurement priorities were reconstructed from the principal's recollection instead. The facilities officer at Warungcaringin described the constraint candidly. The difference is therefore one of documentary continuity rather than of intent, and it should be read alongside the three-year difference in the two principals' tenure recorded in Table 1.

3.2 Inventory and Utilization in the Learning Process

The inventory process serves as the vital administrative backbone of facility management, ensuring accountability and tracking the lifecycle of educational assets. At both research sites, inventory is conducted primarily through manual recording in standardized school inventory ledger books. The objective is to maintain an accurate account of the quantity, physical condition, source of acquisition, and ownership status of all facilities and infrastructure. The Principal of SD Negeri Warungcaringin emphasized this administrative duty, noting, "Every single item that enters the school premises is immediately recorded in our inventory book. This allows us to easily monitor its condition, track its location, and ensure it is being used appropriately."

Despite the commitment to administrative recording, a critical observation was that the inventory systems at both schools remain largely manual and paper-based. There is a distinct lack of digitalization in asset management. This reliance on manual ledgers occasionally leads to inefficiencies, such as difficulties in rapidly tracing the historical maintenance record of a specific item or generating instant reports for auditing

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purposes. The transition toward digital inventory management represents a significant area for future organizational resilience and administrative transformation [18].

Against the same criterion, inventory reaches the documented level at both schools and the systemic level at neither. The ledgers are maintained and the entries are current, which satisfies the second level. What neither school can do is trace an item's maintenance history from the ledger, because repairs are recorded in a separate log that is not cross-referenced to the inventory number; of the twelve repaired items sampled across the two schools, four could not be matched to their inventory entry at all. This is the specific sense in which the manual system falls short: not that the records are absent, but that they do not connect, so that the inventory cannot feed the maintenance stage and the maintenance stage cannot feed evaluation.

The utilization phase is where the management of facilities most directly intersects with the quality of learning. The research found that the utilization of educational facilities and infrastructure is closely aligned with the thematic and competency-based demands of the current curriculum. Teachers at both schools actively employ available media, teaching aids, and the physical classroom environment to foster active student participation and minimize passive, lecture-based learning. A teacher at SD Negeri Gunungkembang shared, "We make a conscious effort to utilize whatever learning media is available. The goal is to keep the students active, engaged, and prevent boredom during long thematic blocks."

Classroom observations documented this utilization. Desks were frequently rearranged from traditional rows into collaborative clusters to facilitate group work, using the spatial infrastructure to support social-constructivist pedagogy, and science equipment, though basic, was used for hands-on experiments rather than merely displayed. In the segments where this occurred, the classroom atmosphere recorded in the field notes was more interactive than in segments without a facility-based task, and pupils were visibly on task and handling materials. What the observations establish is that the physical tools were put to pedagogical use and that engagement accompanied that use; they do not establish that the tools produced the engagement, since no comparison condition was observed and no measure of learning was taken.

The process-quality indicators defined in subsection 2.3 were recorded as follows (Fig. 2). Instructional planning that names facilities was evidenced in the lesson plans at both schools, more consistently at Gunungkembang, where ten of the twelve plans examined specify the media to be used, against seven of twelve at Warungcaringin. Enacted use was observed in six of the seven lesson segments at Gunungkembang and five of seven at Warungcaringin. The physical condition of the learning space met the process standard for lighting, ventilation and seating in all classrooms observed at Gunungkembang and in four of six at Warungcaringin, where two classrooms rely on a single window for both light and ventilation. Behavioral engagement during facility-based tasks was recorded at both schools, with most pupils visibly on task and handling materials. These indicators describe the condition of the learning process in the lessons observed; they do not measure what pupils learned, and no such claim is made.

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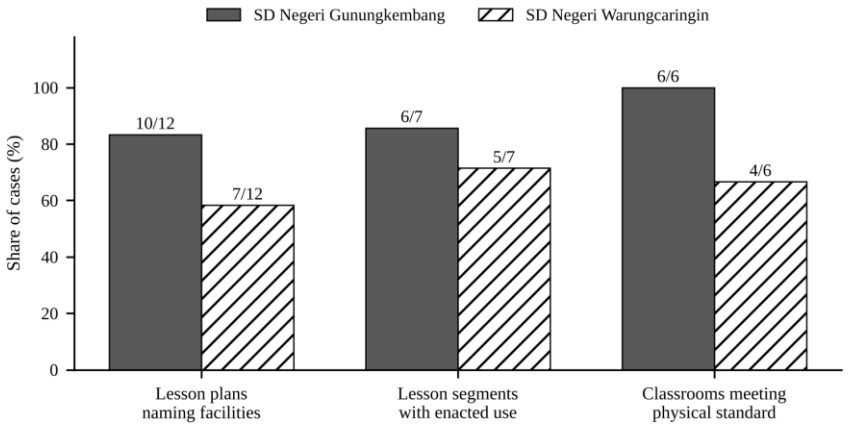


Fig. 2. Three process-quality indicators recorded at the two schools; labels give the observed counts.

3.3 Maintenance, Evaluation, and Systemic Feedback

The longevity and continuous utility of educational facilities depend heavily on rigorous maintenance protocols. The findings reveal that maintenance at both SD Negeri Gunungkembang and SD Negeri Warungcaringin is approached as a collective, school-wide responsibility rather than solely the purview of a designated janitor. Maintenance activities are categorized into routine daily care (cleaning, organizing) and minor preventive repairs. The leadership at both schools plays a crucial role in cultivating a culture of care. The Principal of SD Negeri Gunungkembang stated, "We continuously remind both teachers and students to treat the school facilities with respect. Maintaining the infrastructure is a shared responsibility to ensure it remains viable for future cohorts."

This approach aligns with kindness-based leadership strategies, in which leaders foster an environment that encourages students to take ownership of their surroundings [6]. Students are assigned daily roster duties (piket) to clean classrooms and maintain orderliness, which integrates character education in responsibility and teamwork with facility maintenance. The well-maintained condition of the facilities, as observed and as described by participants, was associated with a sense of comfort and safety in the rooms concerned. Both schools nevertheless acknowledged their limits when facing major structural repairs, which require budgetary allocations beyond routine maintenance funds.

The final phase of the management cycle, evaluation, acts as the critical feedback mechanism. Evaluation of facilities and infrastructure is formally conducted during periodic school meetings and comprehensively at the end of the academic year. The primary objective of these evaluations is to assess the effectiveness of facility utilization, audit the physical condition of assets, and identify items requiring replacement, repair, or disposal. A teacher from SD Negeri Warungcaringin noted,

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"From the evaluations we conduct, we gain a clear understanding of which facilities are lacking, which are broken, and what needs to be prioritized for the next academic year."

This evaluative feedback loop is the point at which the cycle either closes or does not. The data gathered during evaluation are intended to inform the drafting of the subsequent year's RKS and RKAS, and subsection 3.1 reports the extent to which each school achieves that in practice. Where the cycle functions cohesively, from participatory planning and targeted procurement through diligent inventory, active utilization, collective maintenance and systemic evaluation, the process-quality conditions defined in subsection 2.3 were observed to be present. Stated with the caution the design permits, comprehensive facility management is a practice that accompanied those conditions at these two schools; whether it produces them, and whether they in turn improve what pupils learn, are questions this design cannot settle and that subsection 4.1 takes up.

Maintenance reaches the documented level at both schools. Routine care is recorded in the maintenance log and the student duty rosters are kept, but the link to evaluation is weak at both sites: recurrent faults are repaired without being flagged as recurrent, so a fault repaired three times in a year appears in the records as three separate events rather than as a case for replacement. One teacher described the pattern in terms the study has adopted. Evaluation itself reaches the systemic level at Gunungkembang and the documented level at Warungcaringin, for the reason given in subsection 3.1: at the former, its output is traceable into the following plan, and at the latter it is not.

3.4 Cross-Case Comparison of the Six Management Stages

Table 2 applies the three-level criterion of subsection 2.4 to each of the six stages at both schools. Its purpose is to make the comparative claim auditable: a reader can see which stage is rated at which level, what the rating rests on, and therefore whether the description of one school as more organized than the other is warranted and in what specific respect.

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Table 2. Cross-case comparison of the six management stages against the criterion of systemic integration

Stage	SD Negeri Gunungkembang: evidence and level	SD Negeri Warungcaringin: evidence and level	Comparative reading
Planning	RKS and RKAS produced participatorily; three of four deficiencies from the previous evaluation reappear by name in the new RKAS. Systemic	RKS and RKAS produced participatorily; previous deficiencies not carried forward in the document. Documented	Both plan participatorily; only the former closes the loop in writing
Procurement	BOS-funded, with written short-term and long-term priority categories traceable to the RKAS. Systemic	BOS-funded and phased, with priorities set in meetings but not categorized in the document. Documented	Same funding constraint; different degree of documentary specification
Inventory	Manual ledger, current and complete, but not cross-referenced to the maintenance log. Documented	Manual ledger, current, with the same absence of cross-referencing. Documented	Common to both: the ledger records but does not connect to the next stage
Utilization	Ten of twelve lesson plans name the facilities to be used; enacted use observed in six of seven segments. Systemic	Seven of twelve lesson plans name facilities; enacted use observed in five of seven segments. Documented	Use is deliberate at both; planning-to-practice traceability is stronger at the former
Maintenance	Routine care logged; student duty rosters kept; recurrent faults not flagged as recurrent. Documented	Routine care logged; student duty rosters kept; recurrent faults not flagged as recurrent. Documented	Identical at both sites, including the same structural weakness
Evaluation	Year-end evaluation minuted; output traceable into the following RKS and RKAS. Systemic	Year-end evaluation minuted; output not traceable into the following plan. Documented	The decisive difference between the two cases

Read against the criterion, the comparative claim can now be stated precisely. SD Negeri Gunungkembang reaches the systemic level on four of the six stages and SD Negeri Warungcaringin on none, while both reach the documented level everywhere else and neither falls to the emerging level. Describing one school as more organized therefore denotes something specific and limited: not better facilities, not more diligent staff, but greater documentary continuity between stages, concentrated where evaluation should re-enter planning. Two stages are identical at both schools, and the weakness they share — an inventory that does not connect to maintenance, and

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recurrent faults not flagged as such — is structural to the manual system rather than attributable to either school.

This result bears on the study's analytical proposition. The school with more facilities is also the school with the more closed cycle, so the two explanations cannot be separated on this evidence alone. What can be said is narrower and more useful: the stages at which the two schools differ are precisely the documentary ones, which cost nothing to operate, whereas the stages at which they are identical are those constrained by the recording system both use. Closing the loop is therefore a practice the less-resourced school could adopt without additional funding. It must be read with the caution entered in subsection 2.6, that the principal at Gunungkembang has completed four planning cycles against the other's one, which alone could account for the difference.

4 Discussion

The findings show that the management of facilities at both schools runs through the full cyclical process of planning, procurement, inventory, utilization, maintenance and evaluation. This accords with educational management theory, which conceptualizes facility management not as an isolated administrative task but as a continuous cycle integral to school operations [1], [2]. Normatively, the practices observed are consistent with Law Number 20 of 2003 on the National Education System [19], which obliges every educational institution to provide facilities that support the learning process.

Viewed through the theoretical lens of Ludwig von Bertalanffy's General System Theory [5], the management practices observed can be understood as an interconnected system. The planning phase acts as the critical input, heavily influenced by the internal environment (teacher feedback) and external environment (curriculum standards). The participatory nature of this planning—involving principals, teachers, and school committee representatives—reflects a decentralized, democratic approach to resource allocation under the principal's instructional leadership [20]. This aligns with Mulyasa's [21] assertions regarding School-Based Management (MBS), where planning must be deeply rooted in the actual pedagogical needs of the classroom rather than top-down bureaucratic directives. Furthermore, this complies with Government Regulation Number 57 of 2021 on National Education Standards [22], which positions facility planning as a foundational step in fulfilling national education standards.

During the procurement phase, the reliance on the School Operational Assistance (BOS) fund highlights the financial constraints typical of public elementary schools in Indonesia. The strategic prioritization of procurement, driven by budget limitations, supports previous findings by Sanjaya [3], who identified financial capacity as the primary determinant in facility acquisition. Despite these constraints, the schools' ability to incrementally procure necessary teaching aids demonstrates a level of organizational resilience and adaptability [18]. By prioritizing items that have an immediate impact on student engagement, the schools maximize the return on their limited financial investments.

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The inventory process, while systematically executed through manual ledgers, represents a specific area where traditional practices intersect with the need for modern transformation. While the manual recording fulfills the basic requirements of regional asset administration under Minister of Home Affairs Regulation No. 19 of 2016 on the Management of Regional Property [23], it lacks the efficiency and analytical capability of digital systems. The integration of technology into administrative routines, part of the digital transformation that Riyanti et al. [18] associate with organizational resilience, could significantly enhance the transparency, traceability, and forecasting capabilities of the schools' inventory management. Transitioning to a digital database would allow for automated maintenance alerts and easier auditing, thereby strengthening the overall management system.

The utilization of facilities is the nexus where administrative management transforms into pedagogical action. The active use of media and spatial arrangements by teachers to foster interactive learning validates Uno's [24] theory that appropriate instructional models, supported by adequate physical tools, are crucial for creating effective learning environments. This utilization goes beyond mere physical interaction; it encompasses a transformative educational approach that seeks to develop 21st-century competencies such as critical thinking and collaboration [16], [25], [26]. When a teacher utilizes a procured anatomical model, they are not just using an object; they are mediating a deeper cognitive connection for the student.

The physical condition of the learning space, recorded here as the third process-quality indicator, has independent support in the research literature. A large holistic study of primary classrooms reports that design characteristics such as light, air quality, temperature and ownership of the space account for a measurable share of the variation in pupils' learning progress over a year [4]. That finding gives the present observation its weight: the two classrooms at SD Negeri Warungcaringin that depend on a single window for both light and ventilation are not merely below the national process standard as a matter of administrative compliance, they occupy the part of the physical environment where effects on learning have been demonstrated elsewhere. The present study did not measure such effects and does not claim them; it identifies a condition whose significance is established in work with a design capable of testing it.

Maintenance, observed as a collective responsibility, is particularly noteworthy. The instillation of a "culture of care" among students and staff transcends basic facility management and enters the realm of character education. By employing a kindness-based leadership strategy [6], principals foster an environment where students feel a sense of ownership over their school. This approach integrates values of responsibility and environmental care—echoing concepts of ecopedagogy [27]—directly into the daily routines of the school. Preventive maintenance is thus achieved not just through technical repair, but through behavioral conditioning, which is a highly sustainable model for under-resourced schools. Furthermore, maintaining a safe and secure physical environment is a foundational element in broader school management strategies, including the prevention of negative behaviors such as bullying, by ensuring spaces are well-lit, organized, and supervised.

The evaluation phase functions as the feedback loop within Bertalanffy's system: by assessing the condition and utility of assets at year-end, a school generates the data with

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which the cycle begins again. Where that loop closes, as at SD Negeri Gunungkembang, management is not static but adjusts to changing pedagogical needs and physical degradation; where it does not, as at SD Negeri Warungcaringin, each cycle begins substantially from memory. Fig. 3 locates the two points at which the cycle breaks. The holistic management of facilities is in this sense not merely an administrative obligation but a pedagogical one. Budget limitations and manual administration persist at both schools, and the claim this study can support is correspondingly specific: aligning physical resources with instructional goals was associated with the process-quality conditions defined in subsection 2.3 in the lessons observed.

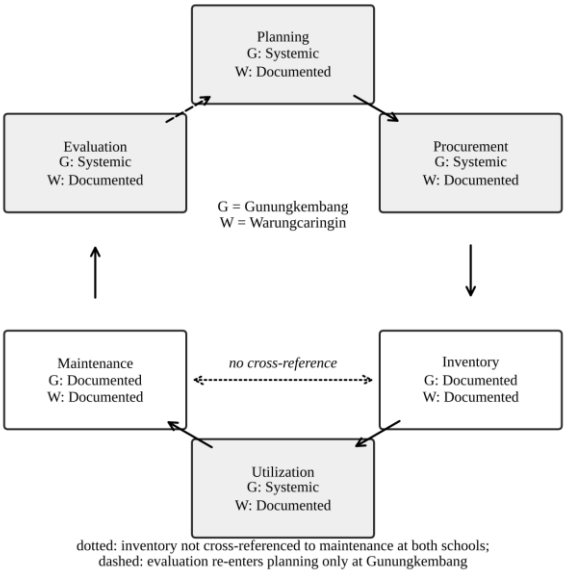


Fig. 3. Levels of systemic integration at each stage and the two points at which the cycle breaks.

4.1 Limitations and Directions for Further Research

Four limitations bound every finding above. First, learning quality is operationalized as process quality and nothing else: no achievement data, test scores or before-and-after measures were collected, so the study reports the conditions of the learning process and the participants' accounts of them, and its findings must not be read as evidence that pupils learned more. Second, the two schools differ in principal's tenure, staffing, enrollment, budget and accreditation; these rival explanations were documented in Table 1 and tested against the evidence rather than controlled, and the difference in tenure in particular cannot be separated from the difference in systemic integration. Third, the three-level criterion is a rule stated by the authors; it is explicit and its

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application is shown in Table 2, but a different rule would produce a different comparison. Fourth, the observational base is seven lesson segments per school, which is sufficient to establish that a practice occurs and insufficient to establish how typical it is.

Three directions follow. A design that holds principal's tenure and enrollment constant while varying the degree of systemic integration would isolate the contribution of the feedback loop, which the present comparison cannot separate from leadership experience. A mixed-methods study pairing the process-quality indicators used here with a validated measure of learning outcomes, administered at two points in a year, would convert the association reported here into a testable proposition. And an intervention study introducing cross-referencing between the inventory ledger and the maintenance log — the one weakness both schools share, and a change requiring no additional budget — would establish whether the structural fault identified here is as consequential as the systemic reading of the cycle suggests.

5 Conclusion

This research concludes that the management of educational facilities and infrastructure at the two schools is implemented through the full six-stage cycle of planning, procurement, inventory, utilization, maintenance and evaluation, but that the stages differ in how far they are integrated into a functioning system. Judged against an explicit three-level criterion, SD Negeri Gunungkembang reaches the systemic level at four stages and SD Negeri Warungcaringin at none, while both reach the documented level elsewhere and neither falls below it. The difference is concentrated at the point where evaluation should re-enter planning, and it is documentary rather than material in character.

Two findings are common to both schools and are, within the limits of a two-case design, the more transferable. The manual inventory ledger records assets accurately but is not cross-referenced to the maintenance log, so that neither school can trace an item's repair history or recognize a recurrent fault as a case for replacement; this weakness is structural to the recording system rather than attributable to either school. And in both schools the use of facilities in lessons is deliberate rather than incidental, planned in the lesson documents and enacted in the majority of the segments observed.

Within the limits set out in subsection 4.1, the study supports a narrow and practical claim. Where the management cycle closes, the process-quality conditions defined here were observed to be present; whether that closure improves what pupils learn is a question this design cannot answer. The recommendations follow from the comparison itself: cross-reference the inventory ledger with the maintenance log, carry evaluation findings by name into the following work plan and budget, and support teachers in naming the facilities a lesson will use at the planning stage. None requires additional funding, which is why these are the recommendations this evidence most strongly supports.

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DECLARATIONS

Author Contributions

Conceptualization, R.C.H. and D.R.; methodology, R.C.H. and D.R.; investigation and data curation, R.C.H.; formal analysis and coding, R.C.H. and D.R.; writing—original draft preparation, R.C.H.; writing—review and editing, D.R.; supervision, D.R. Both authors have read and agreed to the published version of the article.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Research Ethics and Informed Consent

Institutional permission was obtained from the postgraduate program of Universitas Islam Nusantara and, in writing, from both principals. Adult participants gave written informed consent, written parental consent and verbal student assent were obtained before any student data were collected, and participants are referred to by codes only.

Data Availability Statement

The anonymized ATLAS.ti project file, code list, field notes, and document log are available from the corresponding author upon reasonable request. Student focus-group data are not available because they concern minors.

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