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Compliance of Junior Secondary School Building Layouts with the National Education Standards: A Case Study of Depok City

Anedya Wardhani , Yulita Hanifah *

Building Technology, Architecture Program, Faculty of Engineering, Universitas Pancasila

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Abstract

School buildings play a vital role in education by serving as physical spaces for learning and as environments that affect comfort, safety, and the effectiveness of the learning process. At the junior secondary school (SMP) level, the provision of adequate facilities and infrastructure is crucial, as students are in a transitional phase of cognitive and social development that requires a safe and functional learning environment. In urban areas, meeting educational infrastructure standards often faces challenges such as limited land availability, high population density, and increasing student numbers, all of which influence the layout of school buildings. This study aims to evaluate whether the building layouts and facilities of junior secondary schools in Depok City conform to the infrastructure standards set by the National Education Standards. The research uses a descriptive quantitative approach involving 34 schools, considering school capacity, land area, building size, and classroom conditions. The results indicate that land capacity is closer to the standard compared to classroom capacity. However, the imbalance between the number of classrooms and students still leads to classroom overcrowding. Overall, most schools fall into the moderate compliance category (58%), with only a small percentage fully meeting the standards, highlighting the need for improvements in educational infrastructure.

Keywords: school buildings; educational facilities and infrastructure; building compliance evaluation; junior high schools

Kesesuaian Tata Bangunan SMP terhadap Standar Nasional Pendidikan: Studi Kasus Kota Depok

Abstrak

Bangunan sekolah memiliki peran penting dalam penyelenggaraan pendidikan karena tidak hanya berfungsi sebagai ruang fisik pembelajaran, tetapi juga sebagai lingkungan yang memengaruhi kenyamanan, keamanan, dan efektivitas proses belajar. Pada jenjang Sekolah Menengah Pertama (SMP), penyediaan sarana dan prasarana yang memadai menjadi penting karena peserta didik berada pada fase transisi perkembangan kognitif dan sosial yang memerlukan lingkungan belajar yang aman dan fungsional. Di kawasan perkotaan, pemenuhan standar infrastruktur pendidikan sering menghadapi berbagai kendala, seperti keterbatasan lahan, kepadatan penduduk yang tinggi, serta peningkatan jumlah siswa. Penelitian ini bertujuan untuk mengevaluasi kesesuaian tata bangunan dan fasilitas SMP di Kota Depok terhadap standar sarana dan prasarana yang ditetapkan dalam Standar Nasional Pendidikan. Penelitian ini menggunakan pendekatan kuantitatif deskriptif terhadap 34 sekolah dengan mempertimbangkan kapasitas sekolah, luas lahan, luas bangunan, dan kondisi ruang kelas. Hasil penelitian menunjukkan bahwa kapasitas lahan relatif lebih mendekati standar dibandingkan dengan kapasitas ruang kelas. Namun, ketidakseimbangan antara jumlah ruang kelas dan jumlah siswa masih menyebabkan kepadatan kelas. Secara umum, sebagian besar sekolah berada pada tingkat kesesuaian sedang, yang menunjukkan perlunya peningkatan penyediaan infrastruktur pendidikan.

***Kata-kunci**: bangunan sekolah; sarana dan prasarana pendidikan; kesesuaian standar bangunan; evaluasi fasilitas sekolah; sekolah menengah pertama*

*** Corresponding Author**
E-mail: yulitahanifah@univpancasila.ac.id

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Introduction

School buildings constitute an essential component in the provision of education. They function not only as physical spaces for teaching and learning activities but also as environments that shape comfort, safety, and the overall quality of the learning experience. Previous studies have demonstrated that the quality of the physical school environment is closely related to user comfort and the continuity of learning activities [1], [2], [3]. A well-designed and properly managed physical environment has been shown to directly and positively influence the comfort of students and educators, while also contributing significantly to the effectiveness of the teaching and learning process.

Empirical evidence consistently shows that environmental conditions such as thermal comfort, lighting, acoustics, and indoor air quality influence students' concentration, emotional stability, and teaching performance [4]. Research has found a significant relationship between students' perceptions of the school's physical environment and their academic achievement [5]. Large-scale surveys have also identified deficits in thermal comfort, ventilation, and acoustic conditions that directly affect the quality of learning environments [5]. The consistency of these findings is further reinforced by several studies confirming that environmental comfort directly influences student productivity and learning efficiency [6], [7]. These aspects of environmental comfort are closely related to the physical configuration of school buildings, including building orientation, spatial layout, and the arrangement of facilities within the school area. Therefore, evaluating school building layouts is important to ensure that the physical environment of schools supports effective learning spaces.

In general, the relationship between the quality of the physical school environment and learning effectiveness is mediated by key environmental factors, including thermal comfort, indoor air quality, lighting, and acoustic conditions. Therefore, comprehensive management of the physical school environment is an important prerequisite for implementing effective, adaptive, and sustainable learning processes. These aspects of environmental quality are not determined solely by indoor spatial conditions but are also strongly influenced by the building layout within the school area, including building orientation, distances between building masses, the distribution of open spaces, and the zoning of educational functions. Consequently, school layout is an important factor to evaluate to ensure that the spatial configuration of school environments supports optimal learning conditions.

At the junior secondary school (SMP) level, the role of school buildings becomes increasingly strategic, as they accommodate students in a transitional phase of cognitive and social development, requiring a safe, healthy, and functional learning environment. Therefore, providing educational facilities and infrastructure in accordance with established standards is an essential prerequisite for supporting educational quality. The quality of indoor environments has been shown to significantly influence students' comfort and learning productivity [6]. In addition, the availability of adequate facilities and infrastructure has been identified as a supporting factor in creating a conducive school environment [8]. Environmental cleanliness, as part of school facility standards, has also been shown to contribute to improving students' learning concentration [9].]. Thus, at the junior secondary school level, the quality of school buildings and the adequacy of educational facilities and infrastructure form a strategic foundation for creating a safe, healthy, and conducive learning environment that directly supports students' concentration, productivity, and learning quality during this transitional developmental phase.

The Indonesian government, through the Ministry of Primary and Secondary Education, has established standards for school facilities and infrastructure as part of the National Education Standards. These standards regulate requirements for land area, building layout, learning spaces, supporting facilities, and sanitation infrastructure, all of which must be aligned with the number of students and educators. The standards serve as a minimum reference to ensure that school buildings meet functional, technical, and safety requirements.

In urban contexts, meeting school building standards becomes increasingly complex due to land constraints, high population density, and growing student populations. Various studies have shown that schools in urban areas often face spatial constraints that affect building layouts and the effectiveness of facility use. A study conducted in Dalian, China, for example, found that population density may be positively correlated with school quality because it encourages greater investment in education [10]. However, in slum areas or poorly planned urban environments with severe land scarcity, meeting these standards becomes more difficult and may require alternative design approaches, such as compact building concepts [11]. These findings indicate that land scarcity represents the primary constraint, while the impact of population density largely depends on the level of supporting investment and planning.

As a satellite city in the Greater Jakarta Area, Depok City in West Java is also facing increasing demands for educational infrastructure. This condition may affect the conformity of school buildings to existing standards, particularly regarding space availability, building layout, spatial arrangement, and the utilization of school facilities.

A review of previous studies indicates that school buildings in practice often do not fully meet the established standards [2], [9], [12], [13]. Such discrepancies may occur in spatial quantity, facility quality, or building mass configuration, resulting in less-than-optimal conditions for user needs. These conditions not only affect comfort and effectiveness but also increase maintenance burdens and limit long-term development of school buildings.

On the other hand, evaluations of school buildings are often conducted partially, for example, by assessing the presence of facilities without considering their relationship with the number of students, the number of teachers, and the overall master plan of the school buildings. In fact, the school master plan plays an important role in determining the effectiveness of space utilization and the sustainability of facility development, particularly in urban areas with limited land availability. Evaluations that integrate physical building data, user data, and official standards are expected to provide a more comprehensive understanding of the level of conformity of school buildings.

Based on this background, this study aims to evaluate the conformity of the building layout and facilities of junior secondary schools in Depok City, West Java, with the standards for educational facilities and infrastructure established by the Ministry of Primary and Secondary Education as part of the National Education Standards. The evaluation compares the actual conditions of school buildings, including master plans, facility data, and student and teacher counts, against applicable regulatory standards. In addition, the study identifies building components that most frequently exhibit non-compliance and discusses the factors influencing these conditions based on findings from literature.

The contribution of this study lies in presenting an empirical evaluation of the conformity of junior secondary school buildings to official standards in an urban context. The findings are expected to serve as a basis for school administrators and stakeholders to determine improvement priorities, develop school master plans, and formulate more targeted strategies for school building maintenance. Therefore, evaluating school building layouts becomes important for understanding the extent to which the spatial configuration of educational environments complies with national standards for educational facilities and infrastructure.

Methods

This study employs a descriptive quantitative approach, using a conformity evaluation method based on the National Education Standards for junior secondary school facilities and infrastructure. The evaluation is conducted by comparing the existing conditions of school buildings against the regulatory parameters set out in national regulations governing educational facilities and infrastructure.

Data Collection Methods

The research objective includes all public junior secondary schools in Depok City, totaling 34 schools. These schools were selected based on the availability of data on school capacity, site and building area, and room conditions. The classification of school types refers to the number of learning groups according to the regulation of the Directorate General of Primary and Secondary Education, Ministry of National Education of the Republic of Indonesia, Number 541/C.C3/Kep/MN/2004 (Type A, A1, A2, B, B1, and others) [14]. This classification is used as a reference for grouping results and conducting the analysis. The study is evaluative in nature, in which measurement results are directly compared with the ideal standards established by national regulations.

The data used in this study consist of secondary data and spatial processing results compiled from multiple sources. School capacity data include the number of students, the number of learning groups, the number of classrooms, and the student–class ratio, obtained from the online educational administration databases Sekolah Kita and Dapo Kemendikdasmen managed by the Ministry of Primary and Secondary Education [15], [16].

Data on the physical condition of rooms, including the condition status of classrooms, libraries, and laboratories, were obtained from the online database of educational facilities and infrastructure. Meanwhile, physical data related to the site and buildings, such as site area, building area, footprint area, building coverage ratio (BCR), number of building masses, as well as distances between buildings and distances from buildings to the site boundary, were obtained through the compilation of school documents and spatial measurements [17].

Data Analysis Methods

As a basis for the conformity evaluation, this study refers to national regulations governing the standards of facilities and infrastructure for junior secondary schools as stipulated in the Regulation of the Minister of National Education on Educational Facilities and Infrastructure Standards, as well as technical documents issued by the Ministry of Public Works and Housing (PUPR). The main regulation used in this study is Permendiknas No. 24 of 2007 concerning Educational Facilities and Infrastructure Standards, which continues to serve as a technical reference in various educational facility planning documents [18]. Although several educational regulations have been updated, spatial parameters related to site capacity, classroom ratios, and building mass layout at the junior secondary school level still refer to these technical provisions and derivative documents issued by the Ministry of Public Works and Housing as stated in Circular Letter of the Directorate General of Human Settlements PUPR No. 47/2020 [19]. These regulations serve as normative parameters for comparing schools' existing conditions against the applicable standards, as explained in more detail in Table 1.

The conformity assessment was conducted across four main domains: classroom capacity and ratio (CC), site capacity (SC), massing and building layout (MC), and physical condition of the building (PC). The indicators used in each domain were selected based on parameters explicitly stated in national regulations and those that can be physically observed and measured in school buildings. The selection of indicators refers to the provisions for educational facilities and infrastructure at the junior secondary school level as stipulated in the relevant regulations. Accordingly, the indicators used in this study are limited to aspects with quantitative parameters or physical criteria that can be directly verified through field observations or administrative data.

In the classroom capacity domain, the indicators include the number of classrooms relative to learning groups and the student–class ratio. In the site capacity domain, the indicators include site area, building area, and the area-to-student ratio. In the building layout domain, the indicators include the distances between buildings and from buildings to the site boundary, building orientation, and the building coverage ratio. Meanwhile, the building's physical condition domain

Table 1. Indicators for School Conformity Assessment Based on Regulatory Standards

Domain	Indicator	Standard	Regulatory Reference
Classroom Capacity (CC)	CC1: Conformity of Number of Learning Groups	Learning groups < 27	[18], [19]
	CC2: Conformity of Number of Students per Class	Adjusted according to the PUPR No. 47/2020 based on number school type	[18], [19]
	CC3: Conformity of Number of Classrooms Based on Learning Groups	Number of classrooms > number of learning groups	[18], [19]
Site Capacity (SC)	SC1: Conformity of Site Area Based on Number of Students	Adjusted according to the PUPR No. 47/2020 based on number school type	[18], [19]
	SC2: Conformity of Minimum Building Footprint Area	Adjusted according to the PUPR No. 47/2020 based on number school type	[18], [19]
	SC3: Conformity of Building Footprint Area Based on Number of Students	Adjusted according to the PUPR No. 47/2020 based on number school type	[18], [19]
Massing and Building Layout (MBL)	MBL1: Conformity of Distance Between Facing Buildings	Adjusted according to the PUPR No. 47/2020 based on number of floors	[18], [19]
	MBL2: Conformity of Distance Between Adjacent Buildings	Minimum 3 meters	[18], [19]
	MBL3: Conformity of Building Orientation	Elongated orientation East–West or close to this direction	[18], [19]
	MBL4: Conformity of Building Coverage Ratio	< 75%	[17]
Physical Condition (PC)	PC1: Classroom Damage Level	Based on building condition classification	[19]
	PC2: Library Damage Level	Based on building condition classification	[19]
	PC3: Laboratory Damage Level	Based on building condition classification	[19]

evaluates the condition of classrooms, libraries, and laboratories based on building condition classifications.

By limiting the indicators to aspects that can be physically measured in accordance with regulatory standards, this study focuses on evaluating spatial conformity and building capacity. It does not include managerial, curricular, or other non-physical aspects contained in the National Education Standards. Each conformity indicator is assessed by comparing its current value to the minimum standard value.

Indicator scores are normalized to the range 0–1, where 0 indicates non-compliance with the standard and values closer to 1 indicate greater conformity to the standard. For ratio-based indicators, the score is calculated by comparing the existing value with the standard value, with a maximum limit of 1, using Equation 1.

$$Score_i = min\left(\frac{X_{exsisting}}{X_{standard}}, i\right)$$

where $X_{existing}$ represents the actual value observed in the school, and $X_{standard}$ represents the minimum value specified in the regulation.

The index value at the domain level is obtained by taking the simple average of the indicator scores within that domain. Subsequently, the overall school conformity index is calculated as the average of the three conformity domains (CC, SC, and MBC). Meanwhile, the damage index is calculated from the average scores of classroom, library, and laboratory conditions, which have been converted to a 0–1 scale based on the building condition classification.

The indicators used in this study are directly derived from regulatory parameters stated in the national standards for educational facilities and infrastructure. Therefore, the study employs indicators that are operationally defined in the technical standards. This approach is also intended to maintain data consistency and reliability by using official administrative data sources and cross-verifying school data with spatial measurement results.

Results and Discussion

School Profiles and Characteristics

A total of 34 junior secondary schools in Depok City were analyzed based on school type, building age, number of learning groups, site area (SA), and building footprint area (BFA) (Table 2). Site area (SA) is the total land area of the school site, while building footprint area (BFA) is the ground-level area occupied by buildings. Most schools are classified as Type A (21 schools), followed by Type B1 (6 schools), Type A2 (4 schools), Type A1 (2 schools), and Type B (1 school).

Table 2. General Profile and Physical Characteristics of Schools. SA: Site Area; BFA: Building Footprint Area

School Type	n	Avg. Age (years)	Avg. LG	Avg. SA (m^2)	Avg. BFA (m^2)
A	21	30,81	32,62	6447,36	2552,10
A1	2	8,50	24,00	6940,85	1744,50
A2	4	11,00	22,00	25211,10	1456,10
B	1	3,00	18,00	3835,00	1906,00
B1	6	7,33	18,00	3840,82	1163,73
Total	34	22,20	27,85	5477,67	2111,64

The average building age of the schools is 22.2 years, with Type A schools having the highest average age (30.81 years) and Type B the lowest (3 years). The average number of learning groups is 27.85; Type A schools have the highest average (32.62), while the other types range from 18 to 24.

From the perspective of land and building characteristics, the average site area (SA) across all schools is 5,477.67 m^2, and the average building footprint area (BFA) is 2,111.64 m^2. Type A2 schools have the largest average site area at 25,211.10 m^2, while Type B schools have the smallest average site area at 3,835.00 m^2. A similar pattern is observed in the building footprint area, where Type A2 shows the highest values.

Overall, these data indicate that schools with more learning groups tend to have larger site areas and building footprints. However, considerable variation in size is observed across school types. These differences will be further analyzed in relation to their conformity with the National Education Standards.

Classroom Capacity and Ratio Conformity

Table 3 presents the conformity index for classroom capacity and ratio, based on three indicators: the conformity of the number of classrooms to learning groups (CC1), the conformity of the number of students per class (CC2), and the conformity of the number of classrooms to learning groups (CC3). The total index value (CC) represents the aggregation of these three indicators.

Overall, the average classroom capacity conformity index is 0.33. Indicator CC2 shows the lowest value (0.01), indicating that most schools do not meet the standard for the number of students per classroom. In contrast, indicator CC3 has a relatively higher value (0.59), suggesting that the alignment between the number of classrooms and learning groups is closer to the standard than the student–class ratio.

Table 3. Conformity Index of Classroom Capacity with the Standard. CC: Classroom Capacity Conformity Index; CC1: Conformity of Number of Learning Groups; CC2: Conformity of Number of Students per Class; CC3: Conformity of Number of Classrooms Based on Learning Groups.

School Type	CC1	CC2	CC3	CC
A	0,00	0,00	0,67	0,22
A1	1,00	0,00	1,00	0,67
A2	1,00	0,08	0,50	0,53
B	1,00	0,00	0,00	0,33
B1	1,00	0,00	0,33	0,44
Total	**0,38**	**0,01**	**0,59**	**0,33**

Based on school type, Type A has a total conformity index of 0.22, which falls into the low category. Type A1 shows the highest value (0.67), although the sample size is limited. Type A2 and B1 fall within the moderate category with values of 0.53 and 0.44, respectively, while Type B is classified in the low category (0.33). Overall, the results indicate that the non-conformity in classroom capacity is mainly driven by the high student-to-class ratio, whereas the availability of classrooms relative to learning groups is relatively adequate. This condition suggests an imbalance between the learning space and the number of students, ultimately leading to classroom overcrowding.

Several studies indicate that limited classroom capacity may therefore affect the adequacy of educational facilities and ultimately influence the quality of the learning process, such as reducing students' focus, increasing stress levels, and limiting interaction during learning activities [20], [21], [22]. In addition, a high teacher–student ratio in secondary schools may disrupt teaching quality and classroom management [23].

These findings highlight that classroom overcrowding, caused by low conformity with capacity standards, can affect the overall quality of the learning process. This issue is therefore not solely related to physical limitations but also reflects broader constraints in school management. In dense urban contexts, where student populations are typically higher than in rural areas, the government may need to reconsider existing design approaches, such as increasing classroom size or adopting higher-rise school typologies. The current national standard [18], [19], which provides spatial requirements based on building configurations of up to three floors, implicitly frames school design within low to middle-rise typologies. Therefore, rather than solely increasing classroom size, there is a need to reconsider the flexibility of planning guidelines, including the possibility of controlled vertical expansion, supported by appropriate structural, safety, and circulation strategies.

Site Capacity Conformity

Table 4 presents the site capacity conformity index based on three indicators: the conformity of site area capacity relative to the number of students (SC1), the conformity of the minimum building footprint area (SC2), and the conformity of building footprint area relative to the number of students (SC3). The total index value (SC) represents the aggregation of these three indicators.

Table 4. Site Capacity Conformity Index with the Standard. SC: Site Capacity Conformity Index; SC1: Conformity of Site Area Based on Number of Students; SC2: Conformity of Minimum Building Footprint Area; SC3: Conformity of Building Footprint Area Based on Number of Students.

School Type	SC1	SC2	SC3	SC
A	0,76	0,29	0,55	0,53
A1	1,00	0,24	0,67	0,76
A2	0,55	0,68	0,50	0,58
B	1,00	0,32	0,81	0,71
B1	0,83	0,50	0,45	0,67
Total	**0,38**	**0,28**	**0,82**	**0,50**

Overall, the average site capacity conformity index is 0.50, which falls within the moderate category. Indicator SC3 shows the highest value (0.82), indicating that, in terms of the ratio between building footprint area and the number of students, most schools relatively meet the standard. In contrast, indicator SC2 has the lowest value (0.28), suggesting that the standard's minimum building footprint area has not been fully met. Based on school type, Type A has a total index value of 0.53 (moderate category). Type A1 shows the highest value (0.76), followed by Type B (0.71) and Type B1 (0.67). Type A2 records a value of 0.58. In general, all school types fall within the moderate category, and none reach the high category.

The results indicate that, when assessed as a ratio to the number of students, school-site capacity tends to be closer to the standard than classroom capacity indicators. This suggests that, in general, the availability of land relative to student density is relatively adequate, indicating the potential for good provision of open and outdoor spaces within school environments. This contrasts with the low conformity in classroom capacity, highlighting an imbalance between indoor and overall site provision.

Previous studies have shown that having open spaces around schools is associated with better cognitive and academic outcomes. For example, more exposure to greenery has been associated with better memory and less inattention during class [24], [25]. Some studies have also demonstrated that green schoolyards can support attention restoration and enhance students' social well-being after breaks [26], [27].

However, adequate site capacity does not necessarily correspond to the availability of green open space. This highlights the need for greater attention from both government and school management when planning and managing outdoor environments to effectively support school activities. These findings are consistent with previous studies, which emphasize that without proper spatial design and management, the availability of land alone may not translate into improved learning environments. Therefore, while site capacity conformity appears relatively adequate, its contribution to educational quality remains contingent upon the quality and usability of outdoor spaces.

Massing and Building Layout Conformity

Table 5 presents the building layout conformity index based on four indicators: conformity of the distance between facing buildings (MBL1), conformity of the distance between adjacent buildings (MBL2), conformity of building orientation (MBL3), and conformity of building coverage ratio (MBL4). The total index value (MBL) represents the aggregation of these four indicators.

Table 5. Building Layout Conformity Index with the Standard. MBL: Building Layout Conformity Index; MBL1: Conformity of Distance Between Facing Buildings; MBL2: Conformity of Distance Between Adjacent Buildings; MBL3: Conformity of Building Orientation; MBL4: Conformity of Building Coverage Ratio.

School Type	MBL1	MBL2	MBL3	MBL4	MBL
A	0,14	0,62	0,14	0,95	0,30
A1	0,00	0,00	0,00	1,00	0,00
A2	0,00	0,75	0,00	0,75	0,25
B	0,00	0,00	0,00	1,00	0,00
B1	0,17	0,17	0,00	0,83	0,11
Total	**0,12**	**0,50**	**0,09**	**0,91**	**0,23**

Overall, the average building layout conformity index is 0.23, which falls within the low category. The indicator with the highest value is MBL4 (0.91), indicating that most schools comply with the building coverage ratio requirement. In contrast, indicators MBL1 and MBL3 have very low values (0.12 and 0.09, respectively), suggesting that the distance between buildings and building orientation do not meet the standards in most schools.

Based on school type, Type A has a total index value of 0.30, Type A2 records 0.25, and Type B1 records 0.11. Type A1 and Type B show total index values of 0.00. Overall, all school types fall within the low category, and none reach the moderate or high categories. The results indicate that building layout represents the lowest level of conformity compared with classroom capacity and site capacity. Although the building coverage ratio generally meets regulatory requirements, the spacing between buildings and building orientation do not fully comply with the standards. This condition indicates limitations in the spatial configuration of building masses within school sites.

Several studies emphasize the importance of spatial layout in supporting the functionality of educational environments, particularly with respect to social control and school safety. For instance, the land coverage ratio plays a significant role in shaping teachers' perceptions of spatial control [27]. Other studies report that, although architectural layout does not always directly influence safety, the morphology of public spaces can enhance natural surveillance, thereby contributing to school environmental security [7]. In addition, flexible spatial layouts are known to promote more diverse social interactions, whereas rigid designs tend to produce more monotonous behavioral patterns [28].

Other studies have also shown that well-designed spatial layouts can improve the distribution of natural light and the visual quality of spaces [28], as well as influence evacuation efficiency during emergency situations such as fires [29]. Overall, these findings highlight that building layout plays an important role in supporting the functionality, comfort, and safety of school environments.

The findings indicating low building layout conformity reinforce the argument that high student density contributes to spatial constraints within school sites. As a result, buildings tend to be positioned in proximity, even when overall land capacity and the availability of open space remain relatively adequate. This condition may have implications for safety, comfort, and the quality of natural lighting. Therefore, a more comprehensive design approach to school layout in urban areas is required to support a more effective learning environment.

Physical Condition

Table 6 presents the physical condition of the building, represented by the damage index of spaces within school buildings. It is based on three indicators: classroom damage (PC1), library damage (PC2), and laboratory damage (PC3). The total damage index (PC) represents the aggregation of these three indicators.

Table 6. Damage Index of Rooms in School Buildings. PC: Building Damage Index; PC1: Classroom Damage; PC2: Library Damage; PC3: Laboratory Damage.

School Type	PC1	PC2	PC3	PC
A	0,36	0,29	0,24	0,29
A1	0,25	0,25	0,25	0,25
A2	0,31	0,29	0,21	0,27
B	0,25	0,25	0,25	0,25
B1	0,23	0,19	0,23	0,22
Total	**0,38**	**0,01**	**0,59**	**0,33**

Overall, the average damage index is 0.33, which falls within the moderate category. Indicator PC1 (classrooms) has a value of 0.38, while PC2 (library) and PC3 (laboratory) record values of 0.01 and 0.59, respectively. These values indicate variations in the physical condition across different types of spaces. Based on the school type, Type A has a total damage index of 0.29, Type A2 records 0.27, Type A1 and Type B each record 0.25, and Type B1 records 0.22. In general, all school types fall within the low-to-moderate category, and no extreme differences are observed among them.

The analysis indicates that the physical condition of school buildings generally remains within operational limits, although it has not yet reached an optimal condition. Variations among indicators also suggest that the level of damage is not uniform across space types. In addition to maintenance practices and operational management, which play an important role in influencing building conditions [13], damage may also be affected by various building characteristics, including spatial layout [30].

Furthermore, previous research suggests that overcrowding may contribute to the deterioration of school infrastructure. Studies have identified overcrowding as one of the key factors leading to building dilapidation, alongside vandalism, inadequate maintenance, and limited funding[32], [33], [34]. These conditions are associated with increased physical stress on building components due to higher usage intensity.

Although no severe building damage was identified in this study, the observed low levels of conformity, particularly in building layout and classroom capacity, may affect the long-term physical condition of school buildings. Over time, these conditions may contribute to accelerated deterioration, which in turn can affect the overall quality of the learning environment. Therefore, it is important for both government authorities and school management to pay closer attention to the development of conformity and maintenance practices. In addition, there is a need to reconsider existing standards to better reflect the spatial and operational realities of urban school contexts.

Building Standard Conformity Based on Space Damage in School Buildings

Table 7 presents the distribution of schools across combinations of standard conformity categories and building damage levels. The conformity categories are classified as High, Moderate, and Low, and the same classification applies to the building damage categories. These combinations produce nine possible conditions (A–I).

Table 7. Building Standard Conformity Based on Building Damage. A: High conformity, High damage; B: High conformity, Moderate damage; C: High conformity, Low damage; D: Moderate conformity, High damage; E: Moderate conformity, Moderate damage; F: Moderate conformity, Low damage; G: Low conformity, High damage; H: Low conformity, Moderate damage; I: Low conformity, Low damage.

School Type	A	B	C	D	E	F	G	H	I
A	0	0	0	10	2	0	7	2	0
A1	0	0	0	2	0	0	0	0	0
A2	0	0	0	3	0	0	1	0	0
B	0	0	0	1	0	0	0	0	0
B1	0	0	0	4	0	0	2	0	0
Total	0	0	0	**20**	2	0	**10**	2	0

Overall, most schools fall into Category D (Moderate Conformity, Low Damage), comprising 20 schools. In addition, 10 schools fall into Category G (Low Conformity, High Damage), and 2 schools fall into Category E (Moderate Conformity, Moderate Damage). Two other schools are classified under Category H (Low Conformity, Moderate Damage). No schools are found in Categories A, B, C, F, or I.

When examined by school type, Type A schools dominate Categories D and G, with 10 and 7 schools, respectively. Type B1 schools show a similar pattern, with 4 schools in Category D and 2 schools in Category G. Types A1 and A2 are mostly found in Category D, with 2 and 3 schools respectively. Type B schools are entirely located in Category D.

The distribution of schools across conformity and building damage categories reveals a critical pattern that extends beyond individual indicators. While most schools fall within the moderate conformity–low damage category, a considerable proportion remain in the low conformity-high damage group, indicating uneven system performance. Notably, no schools are found in the high-conformity, low-damage category, suggesting that full compliance with established standards has not yet been achieved in practice.

This pattern highlights a divergence between regulatory compliance and actual building performance. Similar findings have been reported in previous studies, where compliance with infrastructure standards does not necessarily correspond to improvements in environmental quality or user experience [35], [36], [37]. This suggests that quantitative compliance alone is insufficient to ensure the effectiveness of learning environments.

The absence of high-conformity–low-damage cases further indicates potential limitations in the applicability of current standards. This may reflect a gap between ideal planning assumptions embedded in the standards and the adaptive development processes observed in practice, particularly in dense urban contexts, where spatial constraints and incremental development shape school configurations.

These findings further suggest that low conformity in classroom capacity and building layout may not only reflect immediate spatial inefficiencies but also pose potential long-term risks to the physical condition of school buildings. Over time, increased density and suboptimal spatial configurations may accelerate building deterioration, ultimately affecting the quality of the learning environment. This indicates that the relationship between spatial conformity, building performance, and learning quality is interdependent rather than isolated. As such, the current standards may require reconsideration, particularly in urban contexts where spatial constraints and operational demands differ significantly from ideal planning assumptions. Rather than relying solely on uniform compliance criteria, there is a need to develop more context-responsive planning approaches that better integrate spatial capacity, building performance, and educational outcomes.

Overall, the findings of this study indicate that the primary issue lies not only in the physical degradation of buildings but also in the mismatch between existing spatial parameters and normative standards. This suggests that the National Education Standards may reflect ideal planning conditions, whereas existing school conditions have developed adaptively in response to land constraints and operational needs.

Conclusion

This study aims to evaluate the level of conformity of junior secondary school facilities in Depok City with the National Education Standards and to examine their relationship with building conditions in an urban context. The findings indicate that conformity levels generally fall within the low-to-moderate range, with no schools meeting the threshold for high conformity. The most significant non-conformities are observed in classroom capacity and building layout, particularly regarding student-classroom ratios and insufficient spacing between buildings.

These findings suggest the need to move toward more adaptive and context-responsive planning strategies for school facilities in urban environments. In such contexts, school design and planning should more effectively integrate spatial capacity to improve building performance and educational quality, rather than relying solely on current standardized parameters.

This study employs clearly defined and measurable indicators derived from national standards, enabling the evaluation framework to be replicated in other contexts. However, the study has several limitations, including a small, single-city sample and the use of secondary data for damage assessment, which relies on administrative reporting. Future research may expand the study area, integrate direct field observations, and develop evaluation models that consider the quality of learning spaces, environmental comfort, and overall building performance.

AI Use Declaration

The authors acknowledge using ChatGPT-4 for translation, enhancing language clarity, and grammar checking. The prompts used are "Translate this text with an academic tone into English and paraphrase the text without changing the meaning." The output from these prompts was used to improve grammatical accuracy. While the authors recognize the use of AI, they affirm that they, Anedya Wardhani and Yulita Hanifah, are the sole authors of this article and accept full responsibility for its content, in accordance with COPE recommendations and journal policies.

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