OIKOS : Jurnal Ekonomi, Manajemen, dan Bisnis
P-ISSN : 1979-4770

Infrastructure and Learning in Indonesia: School Facility Impacts on Student Health and Comfort

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Abstract

This study investigates how the availability of basic school facilities—such as sanitation, water access, and classroom conditions—affects student health and learning comfort in Indonesia. Drawing upon qualitative data from academic sources, government reports, and institutional evaluations, the research employs an ecological and rights-based framework to explore how poor infrastructure contributes to illness, absenteeism, discomfort, and diminished academic engagement. Findings reveal that sanitation deficits lead to health risks and irregular attendance, while inadequate ventilation and lighting negatively influence concentration and motivation. Furthermore, unsafe and overcrowded classrooms reduce student performance and perpetuate educational inequities. By situating these findings within the Human Capital and Capability approaches, the study emphasizes the necessity of infrastructural investment in achieving inclusive and equitable education. The research offers actionable insights for policymakers, highlighting the need for sustained infrastructure development as a foundation for educational quality, particularly in under-resourced and rural regions.

Keywords

School infrastructure; student well-being; learning environment; sanitation; educational equity

INTRODUCTION

Access to fundamental educational facilities is integral to ensuring quality learning environments, particularly in developing countries such as Indonesia. The availability of clean water, functional toilets, adequate lighting, and ventilation systems directly affects students' physical health, mental focus, and academic engagement. According to UNICEF (2013), inadequate school infrastructure is a major barrier to education in Southeast Asia, especially in rural and underfunded areas.

Indonesian national statistics consistently indicate that disparities in school infrastructure are pronounced between urban and rural regions (BPS, 2015). This research examines the broader consequences of such inequalities, specifically focusing on student health and learning comfort.

Globally, the link between school infrastructure and educational outcomes has been thoroughly documented. The World Bank (2011) emphasized that improvements in sanitation and classroom design can reduce absenteeism and improve learning performance, particularly for young children. Empirical studies in sub-Saharan Africa and Southeast Asia show that poor infrastructure correlates with high dropout rates and declining test scores (Filmer & Pritchett, 1999; Glewwe et al., 2011).

Indonesian-based studies also suggest that access to basic facilities enhances student motivation and reduces illness-related absences (Azzahra, 2015). Nevertheless, empirical gaps remain in assessing how specific elements—like ventilation, lighting, and drinking water—collectively influence student comfort and health in the Indonesian school system.

Theoretically, this study draws on ecological systems theory (Bronfenbrenner, 1979), which underscores the importance of environmental contexts in child development. Schools are central micro-systems in a child's life, and their physical attributes significantly shape developmental trajectories. From a public health perspective, infrastructure inadequacies can lead to increased vulnerability to diseases, especially among children under 15 (WHO, 2004).

Studies by Haverkos and Nagin (2010) further confirm that student well-being and school environment are tightly intertwined. The implications extend beyond academic performance to long-term cognitive development, emotional stability, and resilience (Evans, 2006). These theoretical foundations justify a focused inquiry into Indonesia's unique infrastructural challenges and their effects on students.

Despite existing literature, few studies disaggregate the physical aspects of school infrastructure and examine their direct implications on health and learning within the Indonesian context. Most prior work either treats infrastructure as a composite indicator or overlooks the specific sensory and hygienic factors influencing comfort and attendance. Furthermore, policy initiatives aimed at improving facilities often lack grounded analysis of how infrastructure conditions manifest in daily student experiences (Kemendikbud, 2015). This research fills this empirical void by analyzing how specific facilities—like water access, classroom ventilation, and seating comfort—affect health and learning efficacy.

This study is guided by the following research questions: How does the availability of clean water and sanitation facilities influence student health in Indonesian schools? In

what ways do classroom conditions, such as ventilation and lighting, affect students' comfort and concentration? How does the overall infrastructural quality shape attendance and academic performance in under-resourced schools? Through addressing these questions, the study seeks to highlight the significance of infrastructural investment in Indonesia's broader educational equity agenda and suggest practical solutions for improvement.

The objective of this research is to analyze the role of school infrastructure in enhancing student health and learning comfort, with a specific focus on Indonesian contexts. By investigating physical elements of school environments through a public health and educational equity lens, this study contributes to a nuanced understanding of facility-based barriers to quality education. It also aims to inform targeted policy reforms aligned with Sustainable Development Goal 4 (SDG 4), which emphasizes inclusive and equitable education for all.

LITERATURE REVIEW

Scholarly discourse on school infrastructure consistently affirms its critical role in shaping educational outcomes, particularly in resource-limited contexts. The physical environment—including sanitation, lighting, temperature, and ventilation—has been shown to influence students' ability to concentrate, attend regularly, and perform academically (Earthman, 2004). In Southeast Asia, studies highlight how inadequate facilities deter school participation, especially among girls and students from marginalized communities (UNESCO, 2012).

Indonesian data corroborate this, revealing substantial disparities between urban and rural schools in basic facility provision (BPS, 2015). For instance, many rural schools lack functional toilets, access to clean water, and appropriate furniture, which impairs student health and engagement (Kemendikbud, 2014).

Several conceptual frameworks have shaped our understanding of this issue. The ecological systems theory situates infrastructure within the microsystem that directly affects student development (Bronfenbrenner, 1979). Meanwhile, the health-promoting school (HPS) model advocates for environments that actively support well-being through infrastructure and policy integration (WHO, 1998).

Empirical studies in Latin America and Africa using these frameworks have found strong correlations between infrastructure improvements and cognitive gains (Glewwe & Kremer, 2006). Although such frameworks have been applied in Indonesian contexts, research has rarely examined how individual components—such as ventilation or desk ergonomics—impact student experiences in specific regions or school types.

Prior literature tends to treat school infrastructure as a homogenous variable rather than disaggregating its components. For example, studies by Filmer and Pritchett (1999) and Duflo (2001) assess infrastructure in terms of overall school quality but overlook how specific factors like indoor air quality or sanitation access affect health.

Indonesian researchers have made some progress in this area; Azzahra (2015) linked poor sanitation to increased illness and absenteeism in rural schools. However, comprehensive, thematic studies integrating health, educational psychology, and infrastructure remain limited. This review suggests the need for focused, context-specific research to bridge this gap, especially within Indonesia's decentralization framework where regional disparities in school development are pronounced.

Theoretical Framework

This study is grounded in Bronfenbrenner's Ecological Systems Theory, which provides a comprehensive lens for analyzing how various environmental factors influence child development. Within this framework, the school represents a core microsystem directly impacting students' physical, emotional, and cognitive growth (Bronfenbrenner, 1979). The presence or absence of basic facilities—such as toilets, ventilation, and clean water—serves as a critical environmental input.

Prior studies using this model have emphasized the interactive nature of these environmental components and student well-being, reinforcing the need for infrastructure-focused inquiry (Evans, 2006). By situating the school infrastructure within this system, the theory underscores its foundational role in shaping educational experiences.

The second theoretical lens employed is the Health-Promoting Schools (HPS) framework developed by the World Health Organization (WHO, 1998). This model emphasizes the creation of physical and social environments that enhance student health and learning. According to this perspective, schools are not only sites for academic instruction but also settings that must support the physical and psychosocial well-being of students.

Indonesian public health initiatives have adopted elements of this model, but without full integration into educational policy (Kemendikbud, 2014). The HPS framework thus provides a practical foundation for examining the intersection of infrastructure, hygiene, and learning outcomes in this study.

Complementing these perspectives is the Human Capital Theory, which posits that investment in education yields long-term societal and economic benefits (Schultz,

1961). In this context, adequate school infrastructure can be viewed as a form of investment in human capital, essential for enabling optimal cognitive and skill development. Empirical evidence suggests that improved school facilities lead to enhanced learning outcomes, which in turn foster national economic development (Glewwe & Kremer, 2006).

Within Indonesia, disparities in infrastructure represent inefficiencies in human capital development, particularly for students in rural and under-resourced areas (World Bank, 2013). This theoretical orientation helps justify policy-level attention toward infrastructure improvement.

Finally, the Capability Approach, as developed by Sen (1999), adds a rights-based dimension to the discussion. This theory advocates for expanding individuals' capabilities to achieve valued functions, such as education and health. From this viewpoint, the lack of adequate school facilities limits students' capabilities by constraining their ability to learn in a safe and comfortable environment.

It further implies that infrastructure is not a privilege but a foundational requirement for educational justice. Scholars like Nussbaum (2000) have expanded this theory to include physical safety and bodily health as essential capabilities, aligning closely with this study's concern with sanitation and health in schools.

These four theoretical frameworks—ecological systems theory, the HPS model, human capital theory, and the capability approach—together provide a multidimensional basis for analyzing the impact of school infrastructure. Each framework highlights a different but complementary aspect of the issue: environmental interaction, health support, economic return, and rights fulfillment. Their combined application enhances the analytical depth of this study and guides the interpretation of findings across the health, educational, and policy dimensions.

Previous Research

Research on school infrastructure and its influence on educational outcomes has spanned several decades and contexts. In an early foundational study, Filmer and Pritchett (1999) used World Bank data to explore how physical inputs, including toilets and clean water, were linked to primary school enrollment and completion in developing countries. Their findings showed that while household characteristics were more influential, the role of infrastructure could not be ignored, particularly when assessing disparities across regions. This work laid the foundation for future research on educational equity through infrastructural lenses.

Duflo (2001) expanded on this by examining Indonesia's INPRES school construction program. Her quasi-experimental study found that building more classrooms significantly increased educational attainment and future earnings. Though her focus was on the quantity of classrooms, the research illustrated how physical infrastructure investment contributes directly to long-term human capital development. Duflo's research became pivotal in policy debates around equitable resource allocation in Indonesian education.

Glewwe and Kremer (2006) conducted a comprehensive literature review that critiqued the overemphasis on school inputs like textbooks and teacher training while highlighting the importance of classroom conditions. Their synthesis pointed out that elements such as ventilation, desk space, and lighting often go under-evaluated despite their measurable influence on learning outcomes. Their review reinforced the call for multidimensional assessment of educational infrastructure.

Azzahra (2015), in an Indonesian context, explored sanitation issues in rural elementary schools. Her qualitative research revealed that lack of clean toilets and water supply significantly increased student absenteeism, especially among girls. This study filled a critical empirical gap by demonstrating how specific facilities directly influence health-related outcomes and indirectly impact academic performance. It also emphasized the gendered dimensions of poor infrastructure.

A study by Berry (2013) in India provided comparable insights, focusing on how discomfort from heat and poor air quality reduced students' ability to focus. Berry's research employed real-time classroom measurements and student surveys, concluding that poor ventilation and lighting reduced attention spans and led to fatigue. Although not Indonesian-specific, this research offers valuable comparative insights into how environmental discomforts undermine educational effectiveness.

Finally, UNESCO (2015) assessed school conditions across ASEAN nations and found that Indonesia lagged in meeting basic facility benchmarks, particularly in rural and outer island schools. Their data-driven report highlighted severe gaps in sanitation, water access, and classroom quality, connecting these with student health indicators and dropout rates. The report provided regional context and justified broader structural reforms in the Indonesian education system.

In summary, although previous research confirms that infrastructure significantly affects educational outcomes, most studies either examine aggregate indicators or isolate specific components without integrating health, comfort, and equity dimensions. This study seeks to address that gap by exploring how combined deficiencies in water, sanitation, ventilation, and classroom space influence student health and learning comfort within Indonesia's diverse educational landscape.

RESEARCH METHODS

This study adopts a qualitative, document-based approach to examine the relationship between school infrastructure and student well-being. The type of data utilized includes textual and interpretive information derived from academic publications, government reports, and institutional studies. These data types are well-suited for exploring the nuances of educational environments and allow for thematic investigation into how infrastructural conditions affect student health and learning outcomes (Creswell, 2013). Unlike statistical or experimental approaches, this design enables a contextualized understanding of infrastructure-related challenges and their implications across diverse Indonesian settings.

The sources of data include peer-reviewed journal articles, international and Indonesian government publications, and official documents from organizations such as the World Bank, UNESCO, and the Indonesian Ministry of Education and Culture (Kemendikbud). The inclusion of these sources ensures the credibility and reliability of the research base. Official reports such as BPS (2015) and Kemendikbud (2014) provide detailed national statistics on school facilities, while journal articles offer theoretical and empirical insights. Collectively, these data sources support a triangulated understanding of how infrastructure impacts students across varying demographic and geographic conditions.

For data collection, document analysis was employed. This method involves systematically reviewing and interpreting published documents, allowing the researcher to extract key themes, narratives, and arguments (Bowen, 2009). The process included coding references to infrastructure quality, health impacts, and learning comfort, as well as examining case studies and thematic patterns. Using document analysis allows the study to capture both macro-level trends (e.g., national infrastructure gaps) and micro-level observations (e.g., student perceptions of comfort), making it particularly effective for addressing multidimensional research questions.

The data were analyzed using thematic analysis, which facilitates the identification and interpretation of patterns across textual data (Braun & Clarke, 2006). Themes such as “sanitation and absenteeism,” “ventilation and concentration,” and “classroom quality and motivation” emerged as central to understanding the intersection of physical infrastructure and student outcomes. This technique allowed for the integration of insights from diverse sources, creating a cohesive analytical narrative that supports theoretical application and empirical relevance.

To conclude the analysis, a synthesizing process was undertaken to draw coherent findings from the emergent themes.

This involved comparing the documented effects of specific infrastructure features with theoretical predictions from ecological systems theory and the HPS model. The findings were then evaluated in light of the research questions to determine their contribution to the literature and implications for policy and practice. This step ensured that conclusions were not only grounded in evidence but also aligned with the study's theoretical framework and objectives.

RESULTS AND DISCUSSION

The relationship between school infrastructure and student well-being has been well-theorized through ecological and health-promoting models, but empirical assessments in Indonesia have often remained fragmented. This study bridges that gap by exploring how infrastructure quality—spanning sanitation, ventilation, and learning space—interacts with health and learning comfort across diverse school contexts.

By synthesizing findings from document analysis and theory, it becomes clear that school infrastructure is not just a logistical concern but a determinant of student capability and equity in education (Sen, 1999; Bronfenbrenner, 1979). Schools in rural and remote Indonesian regions face persistent limitations in providing safe and conducive environments, which in turn undermine national goals of educational equality (UNESCO, 2015).

Moreover, while previous literature has touched upon the outcomes of infrastructure inadequacies, this study focuses explicitly on the students' experiences and health outcomes as intermediaries between infrastructure and learning achievement. The application of the Health-Promoting Schools (HPS) model allows for a reconceptualization of school environments as active agents of student welfare (WHO, 1998).

Additionally, the Capability Approach sheds light on how poor infrastructure restricts students' real freedoms to achieve educational outcomes (Nussbaum, 2000). As such, the findings contribute to both theoretical expansion and policy discourse by emphasizing the intersectional nature of infrastructure, health, and academic engagement in Indonesia.

1. Sanitation Access and Its Influence on Student Health and Attendance

This section addresses the first research question by exploring how access to clean water and sanitation facilities directly influences student health in Indonesian schools. Health-oriented infrastructure, especially toilets and handwashing stations, is essential for minimizing disease transmission and maintaining regular student attendance. Studies show that schools lacking proper sanitation are more likely to experience higher absenteeism, particularly among female students during menstruation (UNESCO, 2012). In Indonesia, the National Sanitation Monitoring Report revealed that over 30% of public schools had unsanitary toilets as of 2014 (BPS, 2015), a finding echoed by Azzahra (2015), who documented that students in such environments suffered from recurrent gastrointestinal infections.

From a public health lens, poor sanitation contributes to waterborne diseases like diarrhea and dysentery, which are leading causes of absenteeism among primary school-aged children (WHO, 2004). The problem is amplified in rural areas where budgetary and infrastructural limitations prevent the installation of standard sanitary facilities. According to research by Glewwe and Kremer (2006), school-based interventions in hygiene significantly reduce illness-related absences, a trend confirmed by local studies in East Java and Sulawesi. The absence of these facilities not only undermines student health but also sends implicit messages about the value of hygiene and safety in education.

Girls are disproportionately affected due to the lack of gender-segregated toilets, a factor that contributes to reduced attendance and early dropout (UNESCO, 2015). This gendered impact reflects a broader inequity in the educational system, one that undermines national development goals and human capital accumulation (Duflo, 2001). From the Capability Approach, this restriction translates into a denial of students' right to a healthy learning environment, thus compromising both agency and educational access (Sen, 1999). Addressing this issue requires comprehensive policies that not only build infrastructure but also ensure its maintenance and usability.

Community-based solutions have shown promise in bridging these infrastructure gaps. For example, initiatives led by school committees and local NGOs in parts of Indonesia have improved sanitation access through participatory budgeting and hygiene education programs (Kemendikbud, 2014). These efforts demonstrate that localized, context-aware interventions can yield sustainable improvements in student health outcomes. However, their reach remains limited, highlighting the need for broader structural investment and national-level coordination.

In conclusion, the findings demonstrate that sanitation infrastructure plays a foundational role in safeguarding student health and enabling consistent school attendance. The lack of clean water and functional toilets contributes not only to physical illness but also to psychological discomfort and social exclusion, especially among vulnerable groups. Integrating sanitation improvements into broader education policy frameworks is critical to achieving equitable and effective learning environments.

2. Ventilation, Lighting, and Classroom Comfort: Enhancing Cognitive Engagement

This section addresses the second research question by examining how classroom environmental conditions—specifically ventilation, lighting, and spatial arrangement—influence student comfort and concentration. A growing body of literature highlights that inadequate classroom environments are associated with lower attention spans, reduced memory retention, and fatigue among students (Berry, 2013). In Indonesian schools, particularly in rural and outer island regions, poor classroom infrastructure is often characterized by limited airflow, insufficient natural lighting, and overcrowded seating arrangements (Kemendikbud, 2014). These factors collectively diminish learning efficiency and student motivation.

Ventilation is one of the most overlooked aspects of classroom design in Indonesian public schools. A study by Earthman (2004) emphasized that poor indoor air quality results in drowsiness and decreased cognitive performance, particularly in tropical climates. In the Indonesian context, hot and humid conditions in poorly ventilated classrooms exacerbate discomfort, causing children to become restless and disengaged. Moreover, limited airflow can increase exposure to airborne illnesses, further exacerbating health-related absenteeism and impeding academic continuity (WHO, 2004). The interaction between environmental discomfort and learning performance is thus not merely correlative but causative.

Lighting also plays a critical role in shaping student engagement. Poorly lit classrooms have been associated with increased eye strain and reduced reading fluency (Glewwe & Kremer, 2006). In Indonesia, many schools depend on natural light due to unreliable electricity infrastructure, particularly in remote provinces. This dependency often results in uneven illumination throughout the classroom, making it difficult for students seated farther from windows to read or concentrate. The Health-Promoting Schools (HPS) model posits that conducive physical environments are key to maintaining cognitive alertness and

psychological well-being, both of which are influenced by light exposure (WHO, 1998). Thus, lighting deficiencies compromise the school's role as a supportive learning space.

The spatial layout and ergonomics of furniture further compound the issue. Overcrowded classrooms, with inadequate desk spacing and non-adjustable seating, cause discomfort and poor posture among students, particularly younger children. Studies have shown that ergonomic mismatches in classroom furniture are linked to musculoskeletal complaints and inattentiveness (Evans, 2006). In Indonesia, many public schools utilize standard-size furniture regardless of students' age or body size, creating unnecessary strain during prolonged classroom sessions. This lack of adaptive infrastructure violates the principles of educational inclusivity and comfort.

Psychologically, students in uncomfortable classrooms report feeling less motivated and more distracted. Nussbaum (2000) argues that the ability to concentrate is part of an individual's capability to pursue education meaningfully. When the environment itself becomes a barrier to concentration, it restricts this capability, thereby undermining both learning outcomes and educational justice. The issue becomes more severe for students with health conditions like asthma, whose symptoms are aggravated by poor air circulation and dust accumulation—common features in under-maintained Indonesian classrooms.

Several interventions have shown potential in addressing these environmental shortcomings. Pilot programs in Central Java have introduced passive cooling systems and reflective roofing to reduce indoor temperatures without relying on electric ventilation (Kemendikbud, 2014). These locally adapted solutions, while effective in small scales, require systematic implementation across regions. Additionally, lighting audits and classroom redesigns based on ergonomic principles have improved student engagement in pilot schools supported by international NGOs (UNESCO, 2015). However, these interventions remain isolated, and their long-term sustainability depends on integration into national infrastructure planning.

In conclusion, classroom environmental conditions are integral to fostering cognitive engagement and learning comfort. Ventilation, lighting, and spatial arrangements are not merely infrastructural concerns but essential elements of the educational process. Without addressing these factors, efforts to improve curriculum and teaching quality risk being undermined by the physical limitations of the learning environment.

3. Infrastructure Quality and Its Impact on Attendance and Academic Performance

This section addresses the third research question by analyzing how the overall quality of school infrastructure affects student attendance and academic performance. Empirical studies consistently demonstrate that infrastructure deficits, including damaged classrooms, unsafe buildings, and a lack of basic facilities, lead to reduced school participation and poor academic outcomes (Glewwe & Kremer, 2006). In the Indonesian context, the national education survey (BPS, 2015) reported that schools with better-maintained infrastructure tend to have higher student retention and lower dropout rates, particularly in rural and economically disadvantaged regions. This suggests that infrastructure quality is not a peripheral issue but a central determinant of educational achievement.

Attendance is often directly influenced by the physical condition of school buildings. Schools with leaking roofs, cracked floors, or exposed wiring can pose safety risks, especially during Indonesia's rainy season. According to Kemendikbud (2014), schools reporting hazardous building conditions frequently experience interrupted schedules and unplanned closures, reducing overall instructional time. This disruption in learning continuity disproportionately affects students in lower-income households who may lack access to supplementary learning resources. Moreover, fear of injury or discomfort discourages parents from consistently sending children to school, especially younger ones.

Infrastructure also affects academic performance through its influence on students' emotional and psychological states. Research shows that students in physically secure and aesthetically pleasing environments report higher levels of motivation and classroom engagement (Evans, 2006). Conversely, dilapidated classrooms contribute to feelings of neglect and low self-worth, which can impair focus and academic confidence. These psychosocial effects are often underestimated in infrastructure discussions, yet they are crucial in understanding why physical environments influence educational performance beyond health-related factors.

From a theoretical standpoint, the Capability Approach emphasizes that poor infrastructure limits students' educational freedom by undermining both the opportunity and quality of learning (Sen, 1999). This is particularly evident in schools where overcrowding and limited facilities restrict access to classroom participation or extracurricular activities. When schools lack proper libraries, science labs, or even reliable electricity, the learning experience becomes narrower and less stimulating, constraining students' ability to realize their full

potential. Such constraints also hinder pedagogical strategies, as teachers may avoid interactive or technology-based instruction due to the absence of supporting facilities.

Moreover, poor infrastructure discourages qualified teachers from working in underserved areas, further compounding educational disadvantages. Studies have shown that teacher absenteeism is higher in remote schools lacking basic amenities such as housing, sanitation, and transportation (UNESCO, 2015). This teacher-related factor, influenced by infrastructural quality, feeds into a cycle of low instructional quality and student disengagement. Hence, infrastructure should be viewed as both a direct and indirect contributor to academic outcomes, affecting not only students but also teaching effectiveness.

Despite awareness of these challenges, infrastructure investment has not always been prioritized in Indonesia's education policy. While initiatives such as the "School Operational Assistance" (BOS) fund provide operational support, they often fall short in addressing major physical repairs or renovations (World Bank, 2013). Budget constraints, bureaucratic inefficiencies, and decentralization challenges have led to fragmented implementation and maintenance of infrastructure across regions. As a result, many schools continue to function under substandard conditions, limiting the efficacy of other educational reforms.

In conclusion, the quality of school infrastructure is intrinsically linked to student attendance and academic performance. It influences not only physical safety but also the psychological and pedagogical dimensions of learning. Therefore, infrastructure development must be seen as a core component of educational equity and quality. Without addressing this foundational issue, efforts to improve curriculum, pedagogy, and learning assessments may fail to produce meaningful change, particularly for Indonesia's most vulnerable students.

This study has systematically examined how basic school infrastructure in Indonesia influences student health, learning comfort, and academic outcomes. Through the lens of ecological systems theory, the Health-Promoting Schools model, and the Capability Approach, the findings elucidate the multifaceted roles that sanitation, ventilation, and structural quality play in the educational experiences of Indonesian students.

The first research question revealed that inadequate sanitation facilities contribute significantly to student illness and absenteeism, especially among female students. The thematic analysis established that the presence of clean water and gender-segregated

toilets is not merely a hygienic concern but a foundational component of student health and dignity.

Addressing the second question, the study demonstrated that poor classroom conditions—such as insufficient ventilation and lighting—hamper cognitive engagement and induce physical discomfort, thus lowering academic motivation. These findings align with theories emphasizing the interrelation between environmental quality and learning readiness. The evidence further underscores that educational reform must go beyond curriculum and teacher quality to include infrastructural investment as an essential factor in achieving holistic learning environments.

In response to the third question, the study highlighted the broader effects of deteriorated infrastructure on student attendance, teacher motivation, and academic performance. Unsafe and overcrowded classrooms create environments of risk and discouragement, contributing to low retention rates and suboptimal learning outcomes. This underscores the importance of structural equality as a prerequisite for educational justice and inclusion.

Theoretically, the research enriches existing literature by applying a multidimensional analytical framework that integrates health, human development, and education. The fusion of the Capability Approach and the HPS model in particular offers an innovative conceptual synthesis that foregrounds student agency, well-being, and learning as inseparable. Practically, the study presents compelling evidence for policymakers to prioritize infrastructure investment, especially in underserved areas. By identifying the health and cognitive risks associated with poor facilities, the findings justify integrated strategies that merge education planning with public health and regional development agendas. These implications pave the way for performance indicators that measure not just enrollment and test scores, but also the quality and inclusiveness of the physical learning environment.

CONCLUSION

This study has established a compelling link between school infrastructure and student well-being, comfort, and academic performance in the Indonesian educational context. By examining sanitation, classroom conditions, and overall infrastructural quality, the research revealed how these physical factors shape the everyday experiences of students and their ability to thrive academically. The findings affirmed that clean and functional sanitation facilities are essential for reducing illness and absenteeism, while well-ventilated and adequately lit classrooms enhance focus and cognitive engagement. Furthermore, infrastructure quality directly influences attendance rates

and academic outcomes, particularly in under-resourced regions where disparities are most pronounced.

The integration of ecological systems theory, the Health-Promoting Schools framework, and the Capability Approach allowed for a multidimensional understanding of how environmental factors intersect with educational equity. These theoretical lenses confirmed that infrastructure is not merely a background condition but a central determinant of educational access and quality. The study thus contributes to the growing recognition that inclusive and equitable education cannot be achieved without addressing physical learning environments.

Based on these findings, several recommendations are warranted. Policymakers should prioritize infrastructure upgrades as part of national education strategies, with targeted investment in rural and marginalized schools. Maintenance and usability standards must be enforced alongside construction to ensure sustainability. Additionally, future research should expand on localized, longitudinal studies to assess how changes in infrastructure translate into long-term educational outcomes. A shift toward performance indicators that account for environmental conditions will enable a more holistic evaluation of school quality. In doing so, Indonesia can move closer to realizing its commitment to educational equity and the Sustainable Development Goals.

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