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Management of WASH Access in Elementary Schools to Support the Healthy School Program

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Abstract

Access to water, sanitation, and hygiene is essential for a healthy school environment and student learning. This study examined WASH access, its relationship with student attendance and academic achievement, and factors influencing its implementation. A mixed-methods approach with a sequential explanatory design involved 27 elementary schools in rural and urban areas selected through proportionate stratified random sampling. Quantitative data were analysed using Spearman's rho and multiple linear regression, while qualitative data were analysed descriptively. Results showed disparities in WASH access. The findings revealed substantial disparities in WASH access between urban and rural elementary schools, with rural schools predominantly experiencing limited or no access. WASH access showed strong positive relationships with student attendance ($p = 0.69$) and academic achievement ($p = 0.92$). WASH access and student attendance simultaneously significantly influenced academic achievement ($p < 0.001$), explaining 84.3% of its variation, with WASH access as the dominant predictor ($\beta = 0.873$). Qualitative findings identified water availability, funding, and external collaboration as supporting factors, while limited infrastructure, budget constraints, and weak institutional capacity hindered implementation. Therefore, integrated WASH improvements are needed, particularly in rural schools.

Keywords

Academic Achievement, Elementary Schools, Environmental Management, Student Attendance, WASH Access.

1. Introduction

Access to Water, Sanitation, and Hygiene (WASH) is a fundamental component in creating a healthy school environment and supporting the learning process and is linked to the achievement of quality education (Grigg, 2026). Elementary school-aged children are particularly vulnerable to health risks such as diarrhea, respiratory infections, and helminth infections when water and sanitation conditions in schools are inadequate (Sharma et al., 2022). Insufficient sanitation infrastructure, particularly facilities that fail to address gender-specific requirements, may discourage regular school attendance by reducing students' comfort, with female students being disproportionately affected (Sommer et al., 2016).

Supportive and health-promoting school conditions can positively influence students' ability to concentrate, maintain well-being, and perform academically (Sharma et al., 2024). WASH access remains unevenly distributed across schools in urban and rural areas. Urban schools commonly experience advantages in terms of infrastructure quality, water supply reliability, and sanitation service management. In contrast, rural schools frequently experience constraints in accessing clean water, adequate sanitation facilities, and proper hygiene services (Nisa et al., 2024). These disparities are closely linked to broader issues such as unequal infrastructure development and resource allocation.

Increasing universal access to water, sanitation, and hygiene services is a crucial part of achieving Sustainable Development Goal 6 (SDG 6), which targets universal WASH access by 2030 (Biswas et al., 2024). In Indonesia, access to WASH is a key priority aligned with the Sustainable Development Goals (SDGs), particularly Goal 6, which emphasizes ensuring the availability and sustainable management of water and sanitation for all (Kusumaningtiar et al., 2024). Despite this commitment, national data indicate that school sanitation conditions remain suboptimal, with many schools lacking adequate toilet facilities and access to clean water (Ardillah et al., 2021). Similar conditions are also observed in Buleleng District, where disparities in WASH access persist across schools.

Previous studies by Satriani et al. (2022) have primarily focused on specific WASH components or determinants of behavior, while comprehensive implementation studies remain limited. A systematic review of WASH research in Indonesia found that most studies focused on water and social or behavior themes, whereas relatively few examined WASH implementation and school settings (Karon et al., 2017; Satriani et al., 2022). The review also highlighted the need for more locally focused research to understand variations in WASH access and challenges across different regions (Abdulahdi et al., 2024; Pradhan et al., 2025). However, limited research has comprehensively analysed WASH access profiles based on service categories (basic, limited, and no access) and examined their relationship with student attendance and academic achievement, particularly in the context of rural and urban disparities. Therefore, this study aims to analyze the profile of WASH access in elementary schools, examine the relationship between WASH access, student attendance, and academic achievement, and identify supporting and inhibiting factors for its implementation in Buleleng District.

This study contributes to the existing literature by providing a comprehensive assessment of WASH access disparities between rural and urban elementary schools using a mixed-methods approach. Unlike previous studies that primarily focused on sanitation facilities or hygiene practices, this study integrates quantitative analysis of the relationships between WASH access, student attendance, and academic achievement with qualitative exploration of contextual factors influencing WASH implementation. The findings are expected to provide evidence to support environmental management and healthy school policies in Indonesia.

2. Literature Review and Hypothesis Development

2.1. WASH Access in Elementary Schools

Water, Sanitation, and Hygiene (WASH) services are essential for creating a healthy and supportive school environment. Adequate access to clean water, safe sanitation, and handwashing facilities supports students' health, comfort, dignity, and participation in learning. According to the WHO/UNICEF Joint Monitoring Programme (JMP), school WASH services are classified as basic, limited, or no service based on facility availability and functionality. In Indonesia, WASH provision supports the Healthy School Program and contributes to SDG 6, which promotes universal access to safe water and sanitation. School infrastructure also includes basic amenities such as drinking water and toilets that support the educational environment (Andrade et al., 2024). However, WASH access remains unequal, particularly between urban and rural schools, due to differences in water availability, infrastructure, financial resources, and facility management. Therefore, improving WASH access requires not only adequate infrastructure but also effective environmental management and institutional support to ensure sustainable and equitable services across schools.

From an environmental health perspective, schools function as micro-systems where physical infrastructure, hygiene behavior, and institutional management interact. Poor WASH conditions are not merely technical deficiencies but also reflect systemic weaknesses in environmental governance, including maintenance systems, resource allocation, and institutional capacity (Nisa et al., 2024; Kusumaningtiar et al., 2024). In this context, the implementation of WASH aligns with the concept of a health-promoting school, where environmental quality supports both health and learning outcomes. Furthermore, the integration of WASH with *Perilaku Hidup Bersih dan Sehat* (PHBS) is essential for strengthening preventive health behavior among students. Studies show that the availability of facilities alone is insufficient without behavioral reinforcement, as hygiene practices significantly influence health outcomes (Sapriana et al., 2020; Ashar, 2022). Therefore, WASH should be understood as a combination of infrastructure provision and behavioral intervention.

2.2. WASH Access in Student Attendance

Student attendance is strongly influenced by environmental conditions within schools, particularly the availability and quality of WASH facilities. Limited access to sanitation facilities can create discomfort, inconvenience, and health risks that discourage students from attending school regularly. Empirical evidence by Chirgwin et al. (2021) and Lawal et al. (2025) shows that inadequate WASH conditions increase absenteeism due to illness and environmental discomfort. This issue becomes more critical when considering gender dimensions. The absence of gender-sensitive sanitation facilities and proper Menstrual Hygiene Management (MHM) significantly affects female students' attendance. Studies in Indonesia demonstrate that inadequate sanitation and lack of privacy contribute to increased absenteeism among adolescent girls (Sommer et al., 2016; Apriyanti & Lufar, 2024). This highlights that WASH access is not only a technical issue but also a social and equity issue in education.

From an environmental management perspective, student absenteeism can be interpreted as an indirect indicator of system failure in WASH service delivery. Schools with limited WASH access often experience a behavioral–environmental feedback loop, where poor infrastructure leads to low utilization and maintenance, resulting in further deterioration of facilities and declining student engagement. This dynamic underscores the importance of integrating infrastructure development with behavioral and institutional interventions. Previous studies have consistently reported a positive association between WASH access and school attendance. Similarly, Sharma et al. (2022) reported that improved WASH services reduced

absenteeism by minimizing the incidence of waterborne and hygiene-related diseases among school children. These findings suggest that improving WASH access is an important strategy for creating healthier school environments that encourage regular student attendance.

H1: WASH access has a positive association with student attendance.

2.3. WASH Access in Academic Achievement

Beyond its impact on health and attendance, WASH access also plays a significant role in shaping students' academic performance. A clean, safe, and hygienic learning environment enhances students' concentration, motivation, and cognitive functioning. Environmental discomfort, poor sanitation, and inadequate hygiene facilities can create distractions and psychological stress, which negatively affect students' ability to learn effectively (Nisa et al., 2024; Gunamantha & Dantes, 2025). The relationship between WASH and academic performance operates through both direct and indirect pathways. Indirectly, improved WASH conditions reduce illness and absenteeism, allowing students to participate more consistently in learning activities. Directly, a well-maintained and hygienic environment improves students' psychological well-being and learning readiness, thereby enhancing academic performance (Sharma et al., 2024).

Moreover, WASH access contributes to the development of positive hygiene behaviors, which are closely associated with discipline, self-regulation, and overall learning engagement. Schools that integrate WASH with health education programs tend to produce better academic outcomes due to the combined effect of improved environmental conditions and behavioral practices (Shalshabilla et al., 2023). Empirical evidence has consistently demonstrated the positive contribution of WASH access to students' academic performance. Sharma et al. (2022) similarly found that improved WASH services contribute to better academic performance by reducing health-related barriers to learning. More recently, Leone and Kamara (2025) highlighted that schools with adequate WASH facilities provide learning environments that support students' cognitive performance and academic success. Collectively, these findings indicate that improving WASH access represents an important strategy for enhancing educational quality in elementary schools.

H2: WASH access has a positive association with academic achievement.

2.4. The Simultaneous Effect on Academic Achievement

Educational outcomes are influenced by multiple interrelated factors that shape students' learning experiences. Adequate WASH access contributes to students' health, comfort, and learning conditions, while regular school attendance enables students to participate consistently in classroom activities and benefit from instructional processes. These factors are therefore expected to complement one another in supporting academic achievement. Previous studies by Sharma et al. (2022) have shown that adequate WASH facilities can improve attendance and academic performance by creating healthier and more supportive learning environments. However, most existing research has examined these relationships separately, focusing primarily on sanitation facilities, hygiene practices, health outcomes, or attendance rather than integrating WASH access, attendance, and academic performance within a single analytical framework. Limited studies have simultaneously examined these relationships, particularly in relation to disparities between urban and rural schools (Logan & Burdick-Will, 2017; Ndum et al., 2025).

This study addresses these gaps by examining the simultaneous contribution of WASH access and student attendance to academic achievement, while considering

the potential direct and indirect relationships among these variables. According to Ahmed et al. (2025), WASH access is expected to influence academic performance directly by providing a healthier and more conducive learning environment and indirectly through improved student attendance. In addition, this study incorporates an environmental management perspective by examining technical, economic, geographical, and institutional factors that influence WASH implementation (Dreibelbis et al., 2013; Valcourt et al., 2020). By integrating quantitative analysis of educational outcomes with qualitative analysis of implementation conditions, this study provides a more comprehensive understanding of how environmental and educational factors interact. This integrated approach contributes to the literature by positioning WASH not only as a health-related service but also as an important determinant of educational participation, academic achievement, and sustainable school environmental management.

H3: WASH access and student attendance simultaneously affect academic achievement.

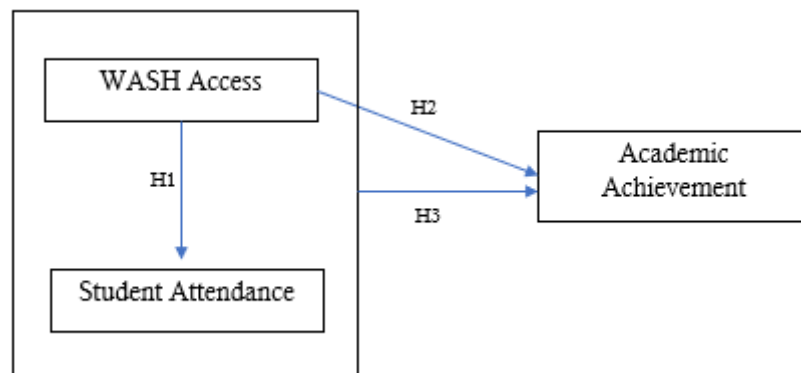


Figure 1. Conceptual Framework

Figure 1 illustrates the conceptual framework examining the relationships among WASH access, student attendance, and academic achievement. H1 indicates that WASH access is associated with student attendance, while H2 indicates that WASH access is associated with academic achievement. Meanwhile, H3 proposes that WASH access and student attendance jointly influence academic achievement, indicating that both factors are considered together in explaining differences in students' academic achievement.

3. Methods

This study employed a mixed-methods sequential explanatory design, integrating quantitative and qualitative approaches to provide a comprehensive understanding of WASH access and its relationship with student outcomes. The quantitative phase was conducted first to examine the statistical relationships between WASH access, student attendance, and academic achievement. This phase was followed by a qualitative phase to explain and deepen the interpretation of the quantitative findings through contextual information obtained from school stakeholders and observations. The study was conducted in Buleleng District, Bali, which encompasses both urban and rural areas and therefore provides a relevant context for examining disparities in WASH access.

The population consisted of all elementary schools in Buleleng District. A total of 27 elementary schools were selected as the research sample using proportionate stratified random sampling to ensure representation of schools from both urban and rural areas. The sample size was determined using the Slovin formula with a 10%

margin of error. Schools were included based on the availability of complete information regarding WASH facilities, student attendance, and academic achievement. The stratification was based on geographical classification to facilitate comparisons between schools with different environmental and infrastructural conditions.

Data were collected through quantitative and qualitative techniques. Quantitative data were obtained using structured questionnaires administered to students to assess perceptions of WASH access, hygiene practices, and learning conditions. The questionnaire employed a Likert scale. Student attendance data were obtained from school records, while academic achievement was measured using students' academic assessment scores. Qualitative data were collected through direct observation of WASH facilities, including water supply, sanitation facilities, and handwashing infrastructure; semi-structured interviews with teachers, principals, and school staff; and document analysis of school reports and relevant administrative records. These methods were used to provide contextual explanations of the conditions and implementation of WASH in schools.

The independent variable was WASH access, which included the availability of clean water, adequate sanitation facilities, separate toilets for boys and girls, and handwashing facilities with soap and running water. The dependent variables were student attendance and academic achievement. Student attendance was measured using absence records for a specified period, whereas academic achievement was measured based on students' academic grades. In the multiple linear regression analysis, student attendance was additionally treated as an independent variable to examine its influence on academic achievement. Supporting and inhibiting factors affecting WASH implementation were examined qualitatively as contextual information.

Quantitative data were analyzed using Spearman's rank correlation to examine the relationships between WASH access and student attendance as well as academic achievement. Multiple linear regression analysis was subsequently conducted to assess the influence of WASH access and student attendance on academic achievement. Spearman's correlation was selected because the questionnaire data were ordinal, while regression analysis was used to examine the predictive relationships among the variables. Qualitative data were analyzed descriptively through data reduction, data display, and conclusion drawing, focusing on technical, economic, geographical, and institutional factors affecting WASH implementation.

4. Results

4.1. Quantitative Findings

The results indicate clear variations in WASH access among elementary schools in rural and urban areas. Of the 10 rural schools, 6 were classified as having limited access and 4 as having no access, while none met the criteria for basic access. In contrast, urban schools demonstrated better WASH conditions, with 11 of 17 schools classified as having basic access and 6 as having limited access; no urban schools were categorized as having no access. These findings demonstrate a clear disparity in WASH access between rural and urban schools in Buleleng District, with urban schools predominantly achieving basic access, whereas rural schools were largely classified as having limited or no access. The distribution of WASH access categories across the 27 elementary schools is presented in Table 1.

Table 1. Distribution of WASH Access Categories by Area

Area	Basic Access (%)	Limited Access (%)	No Access (%)
Urban	64.7	35.3	0
Rural	0	60.0	40.0

The distribution of WASH access categories differed between urban and rural elementary schools. As presented in Table 1, 64.7% of urban schools achieved basic access, while 35.3% had limited access. In contrast, none of the rural schools achieved basic access, 60.0% had limited access, and 40.0% had no access. These findings indicate a substantial disparity in WASH access between urban and rural schools, particularly in the availability of basic WASH services.

Table 2. Results of the Descriptive Analysis

Variable	Mean	Min	Max	Std. Deviation
Score WASH	16.52	6.00	25.00	6.12
Student Attendance (%)	89.18	87.00	94.00	1.69
Score Academic	83.52	77.00	90.00	3.92

Descriptive analysis results presented in Table 2 show that the mean WASH access score was 16.52 (SD = 6.12), with a minimum score of 6.00 and a maximum score of 25.00. The mean student attendance rate was 89.18% (SD = 1.69), with values ranging from 87% to 94%, indicating relatively high attendance levels. Meanwhile, the mean academic score was 83.52 (SD = 3.92), with a minimum of 77.00 and a maximum of 90.00.

The normality test results showed that the significance values for WASH access, student attendance, and academic performance were 0.053, 0.004, and 0.087, respectively. WASH access and academic performance had significance values above 0.05, indicating no significant departure from normality, whereas student attendance had a significance value below 0.05, indicating a non-normal distribution. Therefore, Spearman's rank correlation was applied because at least one variable did not meet the normality assumption.

Table 3. Correlation Coefficient

Variable 1	Variable 2	Correlation Coefficient	Interpretation
WASH Access	Student Attendance	0.69	Strong Positive
WASH Access	Academic Performance	0.92	Very Strong Positive

The Spearman's rank correlation results presented in Table 3 show a strong positive relationship between WASH access and student attendance ($\rho = 0.69$). This indicates that higher WASH access scores tend to be associated with higher student attendance rates. WASH access also shows a very strong positive relationship with academic performance ($\rho = 0.92$), indicating that schools with better WASH access tend to have higher academic scores.

Table 4. Linear Regression Results

Model	Predictor	B	β	t-statistic	P-value	R ²
WASH Access → Student Attendance	WASH Access	0.048	0.702	4.927	<0.001	0.493
WASH Access → Academic Achievement	WASH Access	0.147	0.917	11.521	<0.001	0.842
WASH Access + Student Attendance → Academic Achievement	WASH Access	0.140	0.873	7.704	<0.001	0.843
Student Attendance → Academic Achievement	Student Attendance	0.146	0.063	0.552	0.586	0.843

Based on Table 4, simple linear regression analysis showed that WASH access significantly predicted student attendance ($B = 0.048$, $\beta = 0.702$, $t = 4.927$, $p < 0.001$). The regression model was statistically significant ($F = 24.275$, $p < 0.001$) and explained 49.3% of the variance in student attendance ($R^2 = 0.493$). For each one-unit increase in WASH access, student attendance increased by 0.048 percentage points. WASH access also significantly predicted academic achievement ($B = 0.147$, $\beta = 0.917$, $t = 11.521$, $p < 0.001$). The regression model was statistically significant ($F = 132.731$, $p < 0.001$) and explained 84.2% of the variance in academic achievement ($R^2 = 0.842$). Each one-unit increase in WASH access was associated with a 0.147-point increase in academic achievement.

The multiple linear regression analysis was conducted to examine the combined contribution of WASH access and student attendance to academic achievement. The model was statistically significant ($F = 64.674$, $p < 0.001$) and explained 84.3% of the variance in academic achievement ($R^2 = 0.843$). WASH access remained a significant predictor of academic achievement ($B = 0.140$, $\beta = 0.873$, $t = 7.704$, $p < 0.001$), whereas student attendance was not statistically significant ($B = 0.146$, $\beta = 0.063$, $t = 0.552$, $p = 0.586$). Thus, after controlling for student attendance, each one-unit increase in WASH access was associated with a 0.140-point increase in academic achievement.

4.2. Qualitative Findings

Qualitative findings from interviews and observations showed that WASH implementation was influenced by interacting supporting and inhibiting factors, including water availability, funding, external collaboration, infrastructure, and institutional capacity, as presented in Table 5.

Table 5. Supporting and Inhibiting Factors of WASH Implementation

Category	Factors	Description
Supporting	Water availability	Stable water sources improve WASH implementation
	Funding	Adequate budget supports maintenance
	External collaboration	Government and community support
Inhibiting	Limited infrastructure	Lack of facilities in rural schools
	Budget constraints	Insufficient funds for maintenance
	Institutional capacity	Weak management systems

Based on Table 5, WASH implementation is supported by water availability, adequate funding, and external collaboration. Stable access to clean water facilitates the provision and maintenance of WASH facilities, while sufficient funding supports their maintenance. External collaboration with Community Health Centers (*Pusat Kesehatan Masyarakat*/Puskesmas), government institutions, and parents also contributes to the sustainability of WASH implementation. The supporting factors differ between urban and rural schools. In urban areas, supporting factors are more strongly associated with external support systems, including a stable supply of clean water, collaboration with Puskesmas, and parental participation. These forms of external support complement the availability of WASH facilities and contribute to more organized WASH management. In contrast, supporting factors in rural schools are more closely associated with internal school initiatives, as schools rely more heavily on their own efforts to manage and maintain WASH facilities despite limited resources and infrastructure.

The inhibiting factors are more pronounced in rural areas and include limited access to clean water, inadequate infrastructure, budget constraints, and funding bureaucracy. These constraints restrict schools' ability to provide and maintain adequate WASH facilities. The combination of infrastructure limitations and financial constraints therefore creates additional challenges for sustaining WASH

services in rural schools. In comparison, urban schools benefit from relatively better infrastructure, more stable water access, and stronger external support systems. The qualitative findings indicate that WASH access is not determined solely by the physical availability of facilities. The availability of water resources, financial support, external collaboration, and institutional capacity also influences the sustainability of WASH implementation. The differences between urban and rural schools suggest that improving WASH access requires interventions that address both infrastructure needs and the contextual factors influencing the maintenance and sustainability of WASH services.

5. Discussion

The findings demonstrate a strong positive association between WASH access, student attendance, and academic achievement. WASH access was positively associated with student attendance ($r = 0.69$), consistent with previous evidence that improved water, sanitation, and hygiene conditions can reduce illness-related absenteeism and support school participation. The relationship between WASH access and academic achievement was also very strong ($r = 0.92$). Previous research by Rosemiarti et al. (2026) suggests that access to safe water and sanitation may support children's development, although the strength of this relationship varies across contexts. Using Indonesian longitudinal household data, Lestari et al. (2026) similarly found a positive association between improved water and sanitation access and academic achievement. In the present study, simple regression showed that WASH access significantly predicted student attendance and academic achievement, explaining 49.3% and 84.2% of their variance, respectively. When WASH access and attendance were simultaneously entered into the academic achievement model, WASH access remained significant ($\beta = 0.873$, $p < 0.001$), whereas attendance was not ($\beta = 0.063$, $p = 0.586$). These findings indicate a strong statistical association and predictive contribution of WASH access to educational outcomes but should not be interpreted as evidence of a direct causal effect.

The study also identified substantial disparities between urban and rural schools. Rural schools experienced greater limitations in WASH access, consistent with previous findings that geographical conditions, infrastructure limitations, and resource constraints can hinder WASH provision (Ardillah et al., 2021). Similar geographic disparities in sanitation services have been reported in Indonesia by Odagiri et al. (2021), while Quinan (2025) identified geographic isolation, inadequate water supply, and limited infrastructure as challenges to WASH implementation in rural Philippine schools. These findings indicate that WASH disparities reflect not only differences in physical infrastructure but also broader differences in geographical conditions and resource availability.

The qualitative findings provide further insight into these disparities. In urban schools, WASH facilities were generally better maintained through regular cleaning schedules, student participation, and dedicated cleaning staff. However, several schools remained classified as having limited access because toilet numbers did not meet the standards stipulated in Minister of Education, Culture, Research, and Technology Regulation Number 22 of 2023, particularly the minimum ratio of 1:50 for female students and 1:60 for male students. Limited access was therefore primarily related to service capacity rather than the absence of infrastructure. Some schools also experienced limited water discharge in sinks, resulting in suboptimal handwashing facilities. In contrast, rural schools faced greater constraints related to clean water availability, inadequate infrastructure, funding, and bureaucratic processes, despite relying on internal initiatives to maintain WASH services.

These differences are relevant to educational outcomes because adequate sanitation and hygiene facilities can support student comfort, concentration, and engagement in learning, while poor environmental conditions may negatively affect

cognitive performance and learning efficiency (Leone & Kamara, 2025; Raswati et al., 2025). From an environmental management perspective, WASH should therefore be understood not merely as infrastructure provision but as an integrated system involving technical, institutional, financial, and behavioral components (Ngongo & Tekere, 2026). Rahmat et al. (2026) similarly emphasized infrastructure investment, behavioral approaches, stakeholder engagement, and integration with health and education systems for sustainable WASH interventions. The present findings regarding funding constraints and weak institutional capacity are also consistent with Nisa et al. (2024), highlighting the importance of governance in sustaining WASH programs.

An important qualitative finding is the potential vicious cycle in schools with limited WASH access. Inadequate infrastructure and limited resources may constrain facility use, maintenance, and further improvement, potentially reinforcing poor WASH conditions and educational disadvantages. Although this cycle cannot be established as causal from the present data, it highlights the need for targeted interventions, particularly in rural schools, through infrastructure development, sustainable funding, improved water access, stronger institutional coordination, and the integration of WASH with the PHBS school program. The integration of WASH and PHBS is important because adequate facilities alone may not ensure sustained hygiene practices without behavioral reinforcement and health education. By integrating WASH profiling, statistical analysis of educational outcomes, and qualitative exploration of contextual factors, this study provides a more comprehensive environmental management perspective on WASH disparities and their educational relevance in Buleleng District.

6. Conclusion

This study demonstrates substantial disparities in WASH access between urban and rural elementary schools in Buleleng District, highlighting the importance of integrating WASH with the PHBS school program to support a healthy and sustainable school environment. Urban schools generally had better WASH access, while rural schools experienced greater limitations related to water availability, sanitation facilities, infrastructure, geographic conditions, and resource constraints. The findings also indicate a strong positive association between WASH access and student attendance and between WASH access and academic achievement. Regression analysis further showed that WASH access significantly predicted both attendance and academic achievement, while in the multiple regression model, WASH access remained a significant predictor of academic achievement, whereas attendance was not significant. These findings highlight the importance of adequate WASH provision as part of a healthy and supportive school environment.

The findings have important implications for school management and policymakers. WASH improvement should focus not only on infrastructure but also on sustainable maintenance, adequate funding, institutional capacity, stakeholder coordination, and integration with the PHBS school program. Priority should be given to schools with limited access, particularly in rural areas, to reduce disparities in basic WASH services and support equitable learning environments. The identified vicious cycle highlights the need for sustained institutional and financial support to prevent inadequate WASH conditions from becoming persistent. This study has limitations. Its cross-sectional design prevents causal conclusions regarding WASH access, attendance, and academic achievement. In addition, the limited number of elementary schools in Buleleng District may restrict the generalizability of the findings to other regions. Future research should employ longitudinal or mixed-site designs with larger and more diverse school populations to examine changes in WASH conditions and educational outcomes over time. Further studies should

investigate specific pathways linking WASH conditions to student learning and evaluate targeted WASH interventions, particularly in rural schools.

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Ethical approval was obtained for this study. The manuscript represents original work and has not been previously published, nor is it under consideration by another journal.

Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.



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