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A STUDY ON THE SITUATION OF TOILET SANITATION AND ITS EFFECTS ON THE SECONDARY SCHOOLS STUDENTS OF PASIGHAT BLOCK, EAST SIANG DISTRICT, ARUNACHAL PRADESH, INDIA

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Abstract:
This study investigated the situation of toilet sanitation and its effects on secondary school students in Pasighat Block, East Siang District, Arunachal Pradesh. Utilizing a descriptive survey method with both quantitative and qualitative approaches, data was collected from 5 selected Government Secondary Schools through questionnaires, interviews, and direct observations. A Pearson correlation analysis (n = 218) revealed a statistically significant, moderate, positive correlation between sanitation conditions and student health ($r = 0.397$, $p < 0.001$), strongly suggesting that improved sanitation impacts student health outcomes. A weaker, yet statistically significant, positive correlation was found between sanitation conditions and student academic performance ($r = 0.294$, $p < 0.001$), indicating a limited impact of sanitation on academic performance. Furthermore, an independent samples t-test found no statistically significant difference in the perceived impact of toilet sanitation between male (Mean = 3.626) and female (Mean = 3.721) students ($p = 0.084$). The findings highlight the importance of improved toilet sanitation for student health in Pasighat Block, while suggesting that its influence on academic performance is less pronounced.

Keywords: toilet sanitation, secondary schools, student health, academic performance, Arunachal Pradesh

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1. Introduction

Education opens up a world of possibilities for individuals by equipping them with knowledge. It is the cultivation of learning in diverse ways. One of the most common pathways to education is by attending a formal school and learning from teachers, though education is not limited to that (Dewey, 1916/2019). In a broader sense, education is the process of inspiring discovery and innovation. From the moment we are born, we keep learning—sometimes consciously, and often subconsciously. Therefore, education in its fullest sense encompasses the acquisition of knowledge, skills, values, habits, beliefs, and attitudes (UNESCO, 2015; OECD, 2018).

However, though schooling is nowadays considered an integral component of an individual's development, many children of school-going age—regardless of gender—fail to complete their formal education, thus contributing to dropout rates. Others never enroll, or are unable to enroll, in any form of formal education for a variety of reasons (UNESCO, 2021).

Education plays a crucial role in driving both individual and societal progress, and this is widely acknowledged. Schools ought to be safe havens where students can learn and thrive. Unfortunately, numerous challenges impede effective learning, and a major barrier is the lack of adequate sanitation facilities—especially toilets (Wokadala *et al.*, 2019; Farine *et al.*, 2025). Access to clean and functional sanitation is not merely about hygiene; it is a basic human right and is essential for public health (United Nations, 2010; WHO, 2023). When schools lack proper sanitation, myriad negative consequences emerge- elevated disease risks, increased absenteeism, and less effective learning environments. These factors ultimately undermine students' academic success and well-being (WaterAid, 2012; World Bank, 2018).

Research shows that poor sanitation and hygiene facilities in schools significantly contribute to absenteeism and dropout, particularly among girls (WHO & UNICEF, 2019). School-based water, sanitation, and hygiene (WASH) programs have been associated with improved attendance, reduced illness, and enhanced learning outcomes (UNESCO, 2021; World Bank, 2018). Thus, inadequate sanitation in schools not only infringes upon the dignity and health of children but also hampers their full participation in education (Narayan *et al.*, 2021). Ensuring that all schools provide safe, accessible, gender-sensitive, and hygienic sanitation is a vital step toward inclusive and sustainable educational outcomes (WHO & UNICEF, 2019).

In India, while we've made great strides in getting more kids into school, there are still some big hurdles to jump when it comes to providing fair and quality education for everyone. One major issue is the lack of proper sanitation facilities in schools, especially in rural and remote areas (Narain, 2010). When schools don't have clean and functional toilets, particularly for girls, it can lead to a host of problems like higher dropout rates, trouble focusing in class, and a greater risk of infections (UNICEF, 2015). The Swachh Bharat Mission (Clean India Mission), which kicked off in 2014, aims to boost sanitation coverage across the nation, including in schools. But keeping these facilities clean and

operational is still a tough nut to crack. Arunachal Pradesh, a state in northeastern India, has its own set of geographical and socio-economic challenges that affect access to sanitation in schools (Dickin & Gabrielsson, 2023; Biswas *et al.*, 2024). The East Siang district, with its mostly rural population and limited infrastructure, likely faces similar issues due to hilly terrain, scattered settlements, and inadequate water supply and sanitation facilities (Government of Arunachal Pradesh & UNICEF, 2019; Ministry of Jal Shakti, 2021; World Bank, 2022). That's why Pasighat Block, part of East Siang District, is a great place to explore the real-life situation of toilet sanitation in secondary schools and how it impacts the learning environment.

`This study is all about taking a closer look at toilet sanitation in the secondary schools of Pasighat Block, located in the East Siang District of Arunachal Pradesh. It aims to evaluate how available and functional the toilet facilities are, as well as their cleanliness. Additionally, this research delves into the thoughts and experiences of both students and teachers regarding how these facilities affect the learning environment. By pinpointing the unique challenges and needs of this area, the study hopes to guide specific interventions and policy suggestions that can enhance school sanitation, ultimately fostering a healthier and more supportive learning atmosphere for every student. In the end, this research will shed light on the important connection between sanitation, education, and overall development, especially in the context of a remote and developing part of India.

2. Significance of the Study

This study holds significance at multiple levels. First, it emphasizes that sanitation—often regarded as a peripheral issue—is, in fact, central to ensuring equitable and quality education. By examining the relationship between sanitation, health, and academic outcomes, the study provides empirical evidence to guide policymakers, educational planners, and school administrators in improving learning environments. Second, it highlights the gender dimension of sanitation, demonstrating how the lack of safe and private toilet facilities disproportionately impacts female students, leading to absenteeism and disengagement. Third, the findings align with and contribute to the realization of key Sustainable Development Goals (SDGs), particularly Goal 3: Good Health and Well-Being, Goal 4: Quality Education, and Goal 6: Clean Water and Sanitation, thereby reinforcing the interdependence of health, education, and infrastructure in sustainable development.

2.1 Objectives of the Study

1) To investigate the significant effect of toilets sanitation conditions of the Government secondary schools on students' health.
2) To examine the effects of the toilet situation on the students' attendance and academic performance.

3) To examine the perception of students and teachers toward the sanitation of Pasighat secondary school.

2.2 Hypotheses of the Study

1) There is no significant relationship between Sanitation and Health and Academic Performance of senior secondary students.
2) There is no significant effect of the existing toilet situation on students' attendance and academic performance.
3) There is no significant difference between Sanitation and Health and Academic Performance of senior secondary students in relation to gender.

3. Review of Literature

School sanitation constitutes a vital component of the educational ecosystem, directly influencing students' health, attendance, and learning outcomes—particularly in developing countries where infrastructural disparities are pronounced. A growing body of research underscores that inadequate sanitation facilities in schools are not merely infrastructural shortcomings but systemic barriers to holistic child development, affecting physical well-being, cognitive engagement, and psychosocial growth. Empirical evidence confirms that poor toilet and hygiene conditions have a significant negative impact on students' health and learning capacity (Hossain *et al.*, 2022; Khan, 2023). Inadequate sanitation leads to recurring illnesses such as diarrhea, parasitic infections, and urinary tract diseases, which in turn reduce school attendance and learning time. Studies further show that such health challenges disproportionately affect children in resource-poor and remote settings, where access to clean water and proper waste management remains limited (Wokadala *et al.*, 2019; Owusu & Amankwah, 2024). The relationship between sanitation and educational performance has been well-documented. Wokadala *et al.* (2019) demonstrated that investment in school facilities substantially improves access and learning outcomes in Uganda's primary education sector, a finding echoed in Owusu and Amankwah's (2024) study of Ghanaian schools. These studies affirm that the availability and quality of sanitation infrastructure are critical determinants of academic performance—mediated through improved health, attendance, and psychosocial comfort.

Similarly, Dang and Nguyen (2025) observed that inadequate sanitation contributes to higher absenteeism, with ripple effects on concentration, participation, and eventual learning outcomes. Such evidence collectively reinforces the proposition that sanitation access is not peripheral but integral to educational equity and quality. A persistent gender dimension is evident in this discourse. Research consistently identifies that girls face distinct and heightened challenges related to menstrual hygiene management and privacy (Kassa & Worku, 2022). Lack of separate toilets, absence of disposal bins, and inadequate water facilities often lead to discomfort, embarrassment, and absenteeism during menstruation—constraining female participation and

perpetuating gender gaps in education. Das and Deka (2021) emphasize that menstrual hygiene management is a critical determinant of girls' school attendance and self-esteem, a conclusion supported by more recent evidence from Deka and Das (2024), who show that gender-sensitive WASH interventions yield measurable improvements in participation and psychosocial well-being.

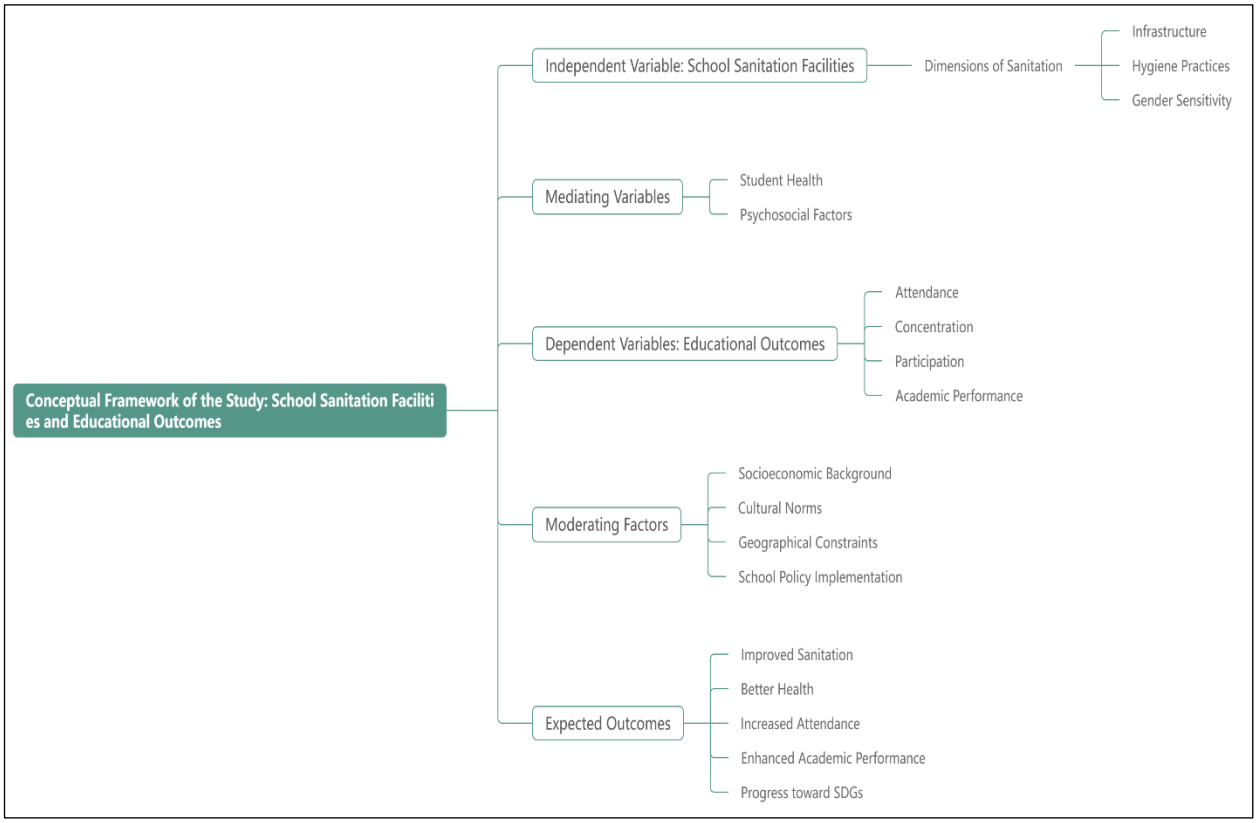
A notable strength of the existing scholarship lies in its methodological diversity and cross-cultural scope. Quantitative investigations provide empirical evidence of the tangible benefits of WASH interventions in schools (Joshi & Singh, 2024), while qualitative research offers deep insight into students' lived experiences of inadequate sanitation environments, including stigma, shame, and discomfort. The geographic breadth of research—from Nigeria (Abubakar *et al.*, 2023) to Afghanistan (Chanu, 2021)—enables a comparative understanding of sanitation-related challenges and innovative, locally driven solutions. These cross-national perspectives reveal that although cultural contexts differ, the core issues of hygiene, accessibility, and maintenance recur globally, reflecting a shared developmental challenge. Despite these advances, the literature still exhibits critical gaps. Much of the existing research focuses on descriptive assessments rather than interrogating the structural, behavioral, and policy-level determinants of poor sanitation. As Hazarika and Mahanta (2021) and Lepcha and Chettri (2021) observe, establishing causal links between sanitation and academic achievement remains a methodological challenge due to the interplay of socio-economic, cultural, and infrastructural factors.

Moreover, while growing attention to menstrual hygiene represents an encouraging shift (Das & Deka, 2021), research seldom explores the cultural taboos and social stigmas that influence sanitation practices in rural and tribal contexts—issues particularly salient in regions like Arunachal Pradesh, where ethnic diversity and geographical isolation shape sanitation behaviors and facility use. The reviewed literature also highlights the transformative potential of WASH programs in enhancing student well-being and engagement. Improved sanitation has been linked to better learning outcomes, reduced absenteeism, and increased self-esteem among school children (Deka & Das, 2024). Furthermore, studies have demonstrated that community participation and local ownership are key to sustaining sanitation initiatives and ensuring accountability in school settings. Case-based analyses from India and sub-Saharan Africa illustrate that successful implementation depends not only on infrastructure but also on governance, behavioral change, and continuous monitoring (Joshi & Singh, 2024; Abubakar *et al.*, 2023).

Nonetheless, there remains an urgent need for longitudinal and context-sensitive research to assess the enduring social, educational, and developmental impacts of sanitation interventions, especially in areas marked by water scarcity, topographical constraints, and financial inequities (Adeel & Tariq, 2022). Arunachal Pradesh, located in the northeastern Himalayas, exemplifies this context—its challenging terrain, dispersed settlements, and socio-economic inequalities continue to impede the establishment and maintenance of functional sanitation infrastructure in schools. These regional disparities

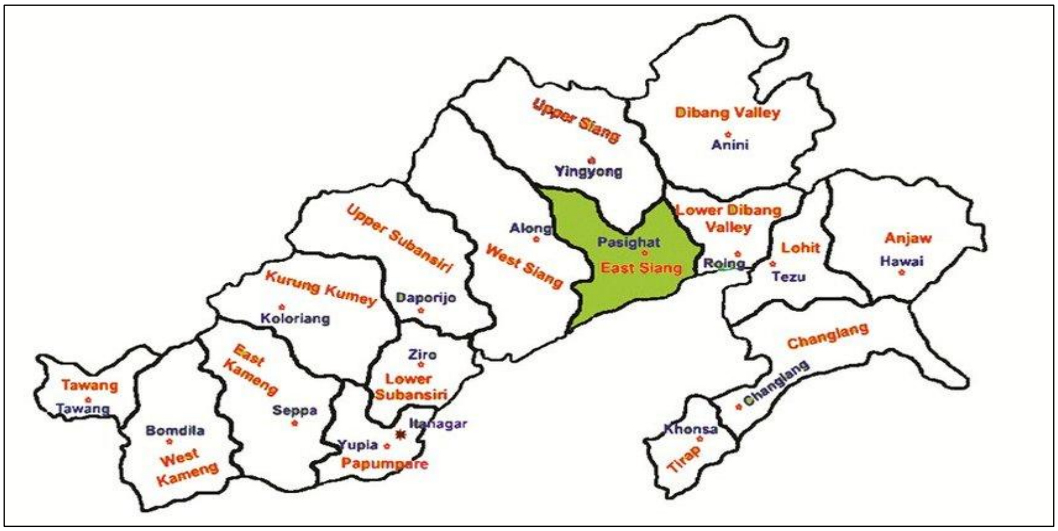
underscore the importance of place-based studies that account for environmental, cultural, and institutional realities shaping sanitation access and use. In summary, the existing scholarship provides a robust conceptual foundation for understanding the multidimensional relationship between sanitation, health, and education, but it also reveals critical research gaps in structural analysis, behavioral inquiry, and gender-sensitive implementation. The present study responds to these gaps by examining the status of toilet sanitation in secondary schools of Pasighat Block, East Siang District, Arunachal Pradesh, and its effects on students' health, attendance, and academic performance. By situating sanitation within the broader framework of inclusive and equitable education, this research contributes to the ongoing global discourse on WASH, gender equity, and the right to quality education.

3. Methodology



3.1 Design

The study adopted a mixed-method descriptive survey design, combining quantitative and qualitative approaches to examine the relationship between school sanitation, student health, and academic performance. Quantitative data measured associations among key variables, while qualitative data from interviews and observations provided contextual insights.



3.2 Study Area and Population

The study was conducted in the Pasighat Block of East Siang District, Arunachal Pradesh, representing both rural and semi-urban settings. The population comprised all students and teachers of government secondary schools within the block.

3.3 Sample and Sampling Technique

A total of five government secondary schools were purposively selected to capture contextual diversity. From these, 218 students of Classes IX and X were chosen through stratified random sampling to ensure balanced representation by gender and age. Additionally, 10 teachers (two from each school) were selected purposively to provide qualitative inputs on sanitation management and student well-being. The sample included 112 male and 106 female students, aged 14–17 years, with equal representation from Classes IX and X. The 10 teachers represented both genders and various subject areas, ensuring diverse perspectives on sanitation-related issues. Tables 1 and 2 below show complete details of the sample demography and statistics.

Table 1: Sample Demography

Sl. no	Type of School	Total Teachers	Gender	Population	Total Students	Gender	Population
1	Government	8	Male	5	76	Male	34
			Female	3		Female	42
2	Government	15	Male	6	75	Male	29
			Female	9		Female	46
3	Government	28	Male	13	124	Male	56
			Female	15		Female	68
4	Government	15	Male	7	87	Male	37
			Female	8		Female	50
5	Government	52	Male	24	150	Male	69
			Female	28		Female	81
Total		**118**					**512**

Table 2: Descriptive Statistics of the Sample (N = 228)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	112	51.4
	Female	106	48.6
Age Group (in years)	14	36	16.5
	15	64	29.4
	16	78	35.8
	17	40	18.3
Class Level	IX	109	50.0
	X	109	50.0
Type of School Location	Rural	3	60.0
	Semi-urban	2	40.0
Teacher Participants	Male	6	60.0
	Female	4	40.0
Total Respondents	Students	218	95.6
	Teachers	10	4.4

3.4 Research Tools

A structured questionnaire was developed by the investigator to assess perceptions of sanitation quality, related health issues, and academic impact using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Semi-structured interviews with teachers were conducted to obtain qualitative insights into sanitation management, challenges, and student well-being, while direct observations of school sanitation facilities were undertaken to validate self-reported data and provide objective information on the availability, functionality, and cleanliness of toilets. Face and content validity were established through expert evaluation by five specialists in education and public health, resulting in a Content Validity Index (CVI) of 0.89, indicating high item relevance and clarity. A pilot study with 15 participants was conducted to test the feasibility, clarity, and appropriateness of the research tools, leading to minor modifications. Reliability testing of the questionnaire produced a Cronbach's alpha coefficient of 0.87, confirming strong internal consistency, with subscale reliabilities of 0.85 for sanitation quality, 0.83 for health perception, and 0.88 for academic impact. These procedures collectively ensured the validity, reliability, and robustness of the research instruments used in the study.

3.5 Data Analysis

The collected data were analyzed using both quantitative and qualitative techniques. Quantitative data from the questionnaires were processed using SPSS (Version 26.0). Descriptive statistics such as mean, standard deviation, and percentage were used to summarize responses, while inferential statistics—including Pearson's correlation and independent samples t-test—were applied to examine relationships between sanitation, health, and academic performance, and to test gender differences. Qualitative data obtained from interviews and observations were analyzed through thematic analysis, identifying recurring patterns and contextual insights related to sanitation management

and student well-being. The quantitative results were interpreted alongside qualitative findings to ensure a comprehensive and integrated discussion, linking numerical trends with participants' real-life experiences for a deeper understanding of the sanitation–education relationship.

4. Results and Findings

This section presents the results of the hypotheses tested, the statistical methods employed, and their interpretations. Both Pearson's Product–Moment Correlation and Independent Samples t-test were used to analyze quantitative data, while descriptive statistics supported the interpretation of sanitation-related conditions and their effects on students' attendance, health, and academic performance.

4.1 Hypothesis 1

H_{01}: There is no significant relationship between sanitation, health, and academic performance of senior secondary students.

Pearson's Product–Moment Correlation Coefficient (r) was applied to assess the degree and direction of the relationship between sanitation, health, and academic performance. This test was deemed appropriate as all variables were continuous, and the objective was to determine linear associations among them.

Table 3: Relationship Between Sanitation, Health, and Academic Performance (Pearson's Correlation Analysis)

Variable Relationship	r-value	p-value	Interpretation
Sanitation ↔ Health	0.397	< 0.001	Moderate, positive, significant
Sanitation ↔ Academic Performance	0.294	< 0.001	Weak, positive, significant

The results (Table 3) indicate a moderate, positive, and statistically significant correlation between sanitation and student health ($r = 0.397$, $p < 0.001$). This finding suggests that improved toilet facilities—characterized by cleanliness, privacy, and functional water supply—contribute to better student health, reduced absenteeism, and enhanced participation. Teachers interviewed during the study corroborated these findings, noting that students in schools with well-maintained toilets "fall sick less frequently," "attend classes more regularly," and "demonstrate higher attentiveness." Several teachers further observed that poor hygiene conditions often lead to "students skipping school during the monsoon season" due to illness and discomfort.

A weak but statistically significant positive correlation was also observed between sanitation and academic performance ($r = 0.294$, $p < 0.001$). This implies that while sanitation has a relatively indirect effect on academic achievement, it exerts considerable influence through its mediating impact on health, attendance, and psychological comfort. Teachers emphasized that "students who feel uncomfortable using school toilets often avoid water intake," leading to fatigue and distraction, which eventually impairs classroom engagement and test performance.

Taken together, these results affirm that sanitation is not a peripheral environmental variable but a critical determinant of student well-being and educational efficiency. Improved sanitation contributes not only to physical health but also to a more conducive and inclusive learning atmosphere. Thus, while the direct link between sanitation and grades may appear modest, the broader ecosystem of hygiene, dignity, and comfort it supports is fundamentally tied to sustainable educational outcomes.

4.2 Hypothesis 2:

H_{02}: There is no significant effect of existing toilet conditions on students' attendance and academic performance.

Descriptive statistical analysis was employed to summarize the frequency and percentage of students reporting various health and academic concerns arising from inadequate sanitation. This approach effectively highlighted the prevalence and patterns of sanitation-related challenges within the sampled schools.

Table 4: Effects of Existing Toilet Conditions on Attendance and Academic Performance

Academic Issue	Students Reporting (n = 218)	Percentage (%)
Missed school due to illness (last 3 months)	89	41%
Felt distracted in class due to discomfort	104	48%
Avoided drinking water to skip toilet use	67	31%
Reported decline in academic performance	58	27%

The data (Table 4) reveal that 41% of students missed school during the previous three months due to sanitation-related illnesses such as diarrhea and urinary tract infections, indicating a direct link between hygiene conditions and attendance. Nearly half of the respondents (48%) reported feeling distracted in class because of discomfort or anxiety related to toilet use, underscoring the psychological dimension of sanitation deprivation. Furthermore, 31% admitted to deliberately avoiding water intake to minimize toilet use, a coping mechanism that can lead to dehydration, fatigue, and reduced classroom concentration. About 27% of students associated poor sanitation with a decline in their academic performance, suggesting that inadequate facilities indirectly undermine learning continuity and engagement.

Teachers' qualitative reflections reinforced these quantitative findings. Several teachers noted that "*students, particularly girls, tend to remain absent during menstruation because of unhygienic or non-functional toilets*." Others observed that "some students hesitate to stay through the full school day" when toilets are dirty or inaccessible. A science teacher remarked, *"The discomfort from unclean toilets distracts even otherwise attentive learners; they simply can't focus when the environment is unhygienic."*

Collectively, these findings highlight that poor sanitation does not merely inconvenience students but systematically erodes attendance, concentration, and academic productivity. The effects are both physiological and psychological—impacting not only physical health but also self-esteem, motivation, and participation. This evidence

reinforces the argument that toilet sanitation is a foundational prerequisite for effective learning environments, especially in resource-constrained rural schools.

4.3 Hypothesis 3

H_{03}: There is no significant difference between male and female students in their perceptions of sanitation, health, and academic performance.

An Independent Samples t-test was conducted to assess gender-based differences in students' perceptions of sanitation, health, and academic performance. This test was appropriate as it compares mean scores between two independent groups—male and female students.

Table 5: Gender Differences in Perceptions of Sanitation, Health, and Academic Performance (Independent Samples t-test)

Group	N	Mean	SD	t-value	p-value	Result
Male Students	108	3.626	0.59	-1.74	0.084	Not Significant
Female Students	110	3.721	0.62			

The findings presented in Table 5 indicate no statistically significant difference between male and female students in their overall perceptions of sanitation, health, and academic performance ($t = -1.74$, $p = 0.084$). This suggests a shared understanding among both genders regarding the relevance of sanitation to their learning and well-being. However, the absence of a statistical difference masks critical qualitative disparities in experience. Interviews with students revealed that female students faced greater practical and psychological challenges, including limited privacy, lack of menstrual hygiene management facilities, and inadequate waste disposal options. Several girls reported missing classes or avoiding school entirely during menstruation, citing "*embarrassment*" and "*discomfort*." Conversely, male students primarily expressed concerns about overcrowded toilets, unpleasant odors, and insufficient water supply, which, while inconvenient, did not deter attendance to the same extent.

Teachers echoed these observations. One senior teacher remarked, *"For girls, sanitation is about dignity and safety, not just cleanliness."* Another observed, *"When facilities are poor, boys complain, but girls quietly stay home."* These reflections underscore that sanitation inadequacies are not gender-neutral in their impact—they exacerbate existing inequalities by disproportionately affecting girls' participation, confidence, and educational continuity.

Thus, while gender differences were not statistically significant, the qualitative evidence affirms meaningful gendered realities that must inform school sanitation policy. Ensuring gender-sensitive facilities—separate toilets for girls and boys, menstrual hygiene resources, and secure, private spaces—is not merely a matter of infrastructure but of educational equity and human rights.

These findings align closely with SDG 4 (Quality Education) and SDG 5 (Gender Equality). SDG 4 advocates for inclusive and equitable education for all learners, while SDG 5 emphasizes eliminating barriers that perpetuate gender disparity. Improved,

gender-responsive sanitation in schools serves as a critical bridge between these goals, fostering safe, dignified, and participatory learning environments that empower every student to attend, learn, and thrive without discrimination.

5. Discussions

The findings of this study clearly demonstrate that school sanitation exerts a significant influence on students' health, attendance, and academic engagement. With 38% of respondents reporting diarrheal illness and 24% experiencing urinary tract infections, the health implications of inadequate sanitation are both immediate and severe. These results corroborate global evidence showing that poor school sanitation heightens the incidence of waterborne and hygiene-related diseases among adolescents (Sommer *et al.*, 2016; UNICEF, 2016). The moderate positive correlation observed between sanitation and student health ($r = 0.397$, $p < 0.001$) reinforces this relationship, affirming that improved sanitation directly enhances students' physical well-being, reduces illness-related absenteeism, and strengthens classroom participation.

However, the relationship between sanitation and academic performance, though statistically significant, was comparatively weaker ($r = 0.294$, $p < 0.001$). This aligns with the findings of Patel (2023) and Wokadala *et al.* (2019), who contend that sanitation affects academic outcomes indirectly, mediated through health, attendance, and psychological comfort. The present study supports this argument: 41% of students reported missing school due to sanitation-related illnesses in the previous three months, while 48% admitted to feeling distracted during lessons because of discomfort or anxiety about toilet use. In such conditions, students' cognitive energy is diverted from learning toward coping with physical unease. Consequently, while immediate declines in grades may not always be evident, the cumulative effects of absenteeism, reduced concentration, and low participation likely undermine long-term academic success.

Teachers' qualitative narratives reinforced these patterns, noting that schools with cleaner, well-maintained toilets witness fewer health complaints and stronger student engagement. One teacher observed that "*students who feel comfortable using school toilets are visibly more alert in class and attend more regularly*." Such testimonies affirm the health–education nexus, demonstrating that the benefits of sanitation extend beyond hygiene to encompass psychological safety, dignity, and attentiveness—key precursors to effective learning.

The descriptive data from Hypothesis 2 further highlight the behavioral and psychosocial dimensions of sanitation deprivation. Students often reported avoiding water during school hours to minimize toilet use—a harmful coping behavior that contributes to dehydration, fatigue, and declining concentration. This behavioral adaptation mirrors findings from Jasper, Le, and Bartram (2012), who argued that inadequate WASH facilities degrade the overall learning environment by constraining both physical health and mental focus. The interplay between sanitation, hydration, and

attention thus underscores that infrastructural neglect translates into cognitive and behavioral costs within classrooms.

While the t-test revealed no statistically significant gender difference in overall perceptions of sanitation ($t = –1.74$, $p = 0.084$), this quantitative similarity conceals deep-seated gendered disparities. Qualitative evidence revealed that female students face distinct challenges related to privacy, menstrual hygiene, and safety. Many girls reported skipping school during menstruation due to the absence of private, hygienic, and functional toilets—a pattern consistent with Das and Deka (2021), who identified menstrual hygiene management as a key determinant of school participation among adolescent girls in India and Northeast India. In contrast, male students primarily cited overcrowding, odor, and water scarcity as concerns, which were less likely to result in absenteeism. This divergence illustrates that sanitation inadequacies, though affecting all students, disproportionately burden girls, reinforcing educational and psychosocial inequities.

These findings align with broader South Asian research linking sanitation and gender equity in education. Studies by Sharma *et al.* (2024) and Pednekar (2024) emphasize that the lack of menstrual hygiene facilities is a primary cause of school dropout and disengagement among adolescent girls, while Dibaba *et al.* (2024) demonstrate that gender-responsive WASH interventions can significantly increase girls' attendance and retention. The present study's qualitative findings echo these conclusions, revealing how gender-sensitive sanitation is central to inclusion, dignity, and sustained educational participation.

Synthesizing the three hypotheses, the study reveals a systemic and interdependent relationship between sanitation infrastructure, student health behaviors, and gendered educational experiences. Sanitation thus emerges as a foundational determinant of well-being and learning rather than a peripheral facility. The empirical evidence shows that sanitation deficits increase illness incidence, contribute to absenteeism, and erode classroom concentration—while simultaneously reinforcing gender inequalities through lack of menstrual hygiene infrastructure and privacy. These multidimensional effects highlight sanitation as both a public health priority and an educational equity concern.

From a policy and theoretical standpoint, the implications are profound. Schools must move beyond infrastructural tokenism toward integrated, gender-responsive sanitation policies that ensure privacy, maintenance, and menstrual hygiene management. Such interventions should be incorporated within broader educational development strategies, particularly in rural and resource-constrained contexts. Aligning with the goals of SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), and SDG 5 (Gender Equality), equitable access to safe and hygienic sanitation is not merely an infrastructural necessity but a pedagogical and human rights imperative. As emphasized by Bick *et al.* (2025) and McMichael (2019), achieving educational equity requires embedding WASH within the very framework of school quality, governance,

and inclusion. Without dignified sanitation, efforts to enhance learning outcomes and close gender gaps will remain incomplete.

6. Delimitations of the Study

- The study was confined to five government secondary schools in Pasighat Block, East Siang District, Arunachal Pradesh; results may not generalize to other districts or private institutions.
- It focused exclusively on students of Classes IX and X and their teachers to maintain sample uniformity.
- The research adopted a survey design, capturing associations rather than causal relationships between sanitation, health, and academic outcomes.
- Data were based primarily on self-reported perceptions, which may be subject to recall or response bias.
- The scope was limited to aspects of toilet availability, functionality, cleanliness, and gender sensitivity, excluding wider infrastructural or policy analyses.
- Despite these delimitations, the study offers valuable, context-specific insights into the sanitation–education relationship in rural Arunachal Pradesh.

7. Recommendations

The findings of this study highlight the urgent need for comprehensive and sustained measures to improve school sanitation, particularly in rural and resource-constrained contexts such as the Pasighat Block of Arunachal Pradesh. Enhancing sanitation infrastructure, ensuring inclusivity, and embedding hygiene education are vital to improving student health, attendance, and academic performance.

- **Infrastructure Expansion and Accessibility:** Schools must construct additional toilets to achieve the recommended 25:1 student-to-toilet ratio and renovate existing facilities for safety, functionality, and universal accessibility. Ramps, handrails, and gender-segregated toilets with adequate lighting, ventilation, and water supply should be prioritized to ensure usability for all students, including those with disabilities.
- **Regular Cleaning and Maintenance:** Sustained functionality requires daily cleaning, effective drainage, and proper waste disposal systems. Sanitation staff should have clearly defined roles and accountability mechanisms, while school administrators must conduct periodic inspections. Maintenance budgets and repair protocols are essential to prevent infrastructure decay.
- **Gender-Sensitive and Inclusive Facilities:** Separate, secure, and hygienic toilets for girls—with dustbins, door locks, and menstrual hygiene facilities—are essential to reduce absenteeism and safeguard privacy and dignity. Gender-responsive sanitation directly supports SDG 4 (Quality Education) and SDG 5 (Gender Equality), ensuring equitable participation in education.

- **Integration of Hygiene Education:** Hygiene education should be systematically integrated into the school curriculum through interactive lessons, demonstrations, and awareness programs on handwashing, menstrual hygiene, and safe toilet practices. This will cultivate lifelong hygiene habits and enhance students' sense of responsibility for maintaining school cleanliness.
- **Student Participation and Community Engagement:** Student-led initiatives such as sanitation clubs or eco-groups should be encouraged to promote ownership and leadership. Collaboration among students, teachers, parents, and community members will strengthen accountability and ensure sustainability in sanitation practices.
- **Policy Integration and Financial Commitment:** Sanitation standards should be incorporated into school quality assurance frameworks, with dedicated funding for construction, maintenance, and repair. Coordinated action among the Departments of Education, Health, and Local Governance is crucial for effective implementation and monitoring.

7.1 Future Research Directions

This study provides important empirical evidence linking sanitation, health, and academic outcomes, but further research is needed to deepen understanding and inform long-term policy.

- **Expanded Scope:** Future studies should include multiple districts to increase generalizability and enable cross-regional comparisons.
- **Longitudinal Approaches:** Tracking the long-term impacts of improved sanitation will help establish causal relationships with health and educational outcomes.
- Psychological and Behavioral Dimensions: Research should explore how poor sanitation affects student anxiety, self-esteem, and classroom engagement.
- **Participatory Models:** Evaluating student-led and community-driven sanitation programs can identify sustainable frameworks for school hygiene.
- **Low-Cost, Gender-Sensitive Innovations:** Studies on affordable and context-specific sanitation solutions, particularly for menstrual hygiene management, will support scalable implementation in resource-limited settings.

In sum, improving school sanitation transcends infrastructure—it is an educational and equity imperative central to promoting health, inclusion, and dignity. Integrating infrastructural, behavioral, and policy-level reforms will help build safe, inclusive learning environments aligned with the aspirations of Sustainable Development Goals 3, 4, and 5.

8. Conclusion

This study establishes that sanitation is not merely a physical infrastructure issue but a determinant of educational equity, health, and human dignity. The empirical evidence

demonstrates that poor sanitation significantly affects students' health, attendance, and academic participation, with 38% reporting diarrheal illness and 41% missing school due to related ailments. The moderate positive correlation between sanitation and health ($r = 0.397$) and the significant, though weaker, correlation with academic performance ($r = 0.294$) confirm that health mediates the sanitation–learning relationship. Moreover, the qualitative findings reveal gendered disparities—girls experience heightened vulnerability due to the absence of privacy and menstrual hygiene facilities. These results echo national and global evidence linking sanitation to inclusive education and gender equality.

In essence, the study argues that achieving quality education requires integrating sanitation as a central pillar of educational policy and school management. Clean, safe, and gender-sensitive toilets are as critical to learning outcomes as textbooks or teachers. Addressing sanitation inadequacies through coordinated infrastructure development, hygiene education, and gender-responsive planning will not only improve academic performance but also foster environments of respect, participation, and well-being. By aligning educational reforms with Sustainable Development Goals 3 (Good Health and Well-being), 4 (Quality Education), and 5 (Gender Equality), the study reinforces that the path to inclusive and equitable education begins with the assurance of dignity and health for every child.

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Authors' Contributions

All authors made substantial contributions to the conception, design, data collection, analysis, and interpretation of the study. They jointly drafted, reviewed, and refined the manuscript, ensuring academic integrity and approving the final version for publication.

- **Enu Sambyal:** Conceptualization; Data Collection; Formal and Statistical Analysis; Resource Management; Writing – Original Draft; Validation.
- **Ratan Sarkar:** Supervision; Conceptual Guidance; Methodology Development; Data Interpretation and Discussion; Writing – Review and Editing; Preparation of Final Draft; Validation.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Neither Dr. Enu Sambyal nor Dr. Ratan Sarkar has any financial or non-financial associations with any organizations, school boards, or governmental departments involved in the Pasighat Block secondary school system that would constitute a conflict of interest during the conduct or publication of this research.

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