

Impact of School Infrastructure on the Performance of Students at Higher Secondary School

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Abstract

This study investigates the influence of infrastructure, including classrooms, labs, libraries, sanitation, and recreation facilities, on both academic and social development (confidence, cooperation, and motivation) of higher secondary students in Rahim Yar Khan, Pakistan, while recognizing the role of school infrastructure as an enabler of inclusive quality education. The Study was designed as a descriptive survey with a concurrent mixed-methods data collection approach (questionnaires, interviews, on-site observations), with 260 sampled higher secondary school principals, teachers, and students from both urban and rural public and private schools. Overall, participants strongly agreed (86–92%) that a safe, clean, well-planned, and accessible infrastructure facilitates teamwork, empathy, and communication skills, and enhances learning outcomes and student confidence in higher secondary education in Pakistan. Notable differences were found between the urban and rural schools in aspects like ICT, co-curricular areas, and inclusive infrastructure. There were also strong positive correlations and good predictive validity between safe, clean, well-maintained facilities and school engagement and achievement levels. The results suggest that infrastructure not only provides support for learning but also significantly molds students' lives, relationships, and development. The study recommends infrastructure policies that ensure availability, accessibility, maintenance, and integration of digital and inclusive design to support the overarching aims of SDG 4, including quality and equitable education.

Keywords

School infrastructure; academic performance; social development; inclusivity; learning environment; Pakistan.

Introduction

Education is a vital means of developing human capital and promoting inclusive social development (Adede, 2012). In addition to cognitive achievement, schools promote emotional intelligence, cooperation, and communication for civic engagement and active participation in learning throughout life (Mutala, 2023; Rasheed et al., 2024). Over recent decades, scholars and practitioners have recognized that the school physical environment (SPE) is not merely a neutral or passive educational context, but has a significant impact on student learning, motivation, and behavior (Obedling,

2024; Naz et al., 2024). The SPE encompasses classroom and laboratory environments, libraries, school sanitation and safety, as well as the psychosocial and affective spaces where students and staff collaborate to achieve their academic and decision-making (Mokaya, 2013; Munawar et al., 2024). Internationally, there is empirical evidence of the link between school facilities and student outcomes. Research from Latin America and Africa has found that school infrastructure accounts for up to 16% of the variation in learning outcomes, even after controlling for student socioeconomic status and teacher quality (Assoumpta & Andala, 2020; ; Ramzan et al., 2023; Fatima et al., 2024; Abbas & Zafar, 2025). Purpose-built spaces designed to support learning promote student engagement, reduce absenteeism, and foster collaboration, while poor infrastructure is associated with higher dropout rates, low morale, and behavioral issues. The idea that a school's architecture should support active learning was first championed by education reformers such as John Dewey, but continues to inform twenty-first-century discussions on inclusive and technology-enabled learning environments (Zafar et al., 2023; Mughal et al., 2023; Mwikali, 2024; Arshad et al., 2024).

Equity issues in school infrastructure remain salient, particularly in many developing contexts, including Pakistan (Yangambi, 2023; Mohiman et al., 2024; Arshad Ahmad & Zafar, 2025). A lack of sufficient classrooms, science laboratories, poor ventilation, and inadequate sanitation facilities are particularly prevalent among female and rural students (Zafar & Akhtar, 2023; Saleem et al., 2024; Arshad, Mehmood & Ahmad, 2025). Policy measures, including the Punjab Education Sector Reform Program (2014–2019), have strengthened science laboratories and enhanced safety and security; however, gaps persist between urban and rural areas. This is especially an issue in the higher-secondary level, when students are preparing for tertiary education or vocational training and need conducive learning and socializing environments (Bhutto & Zafar, 2023; Mumtaz et al., 2024; Shaheen et al., 2025).

This research paper examines the crucial issue of school infrastructure (**Fig. 1**) and its influence on academic achievement and the development of social skills among students. Set against the backdrop of higher secondary schools in Rahim Yar Khan District, Pakistan, this study examines the tangible aspects of educational facilities, including classroom design, the presence of libraries and laboratories, as well as sanitation and safety measures. The objective is to unravel the tangible connection between the physical learning environment and students' academic performance and their ability to develop and apply essential social skills. By contextualizing local findings within the global

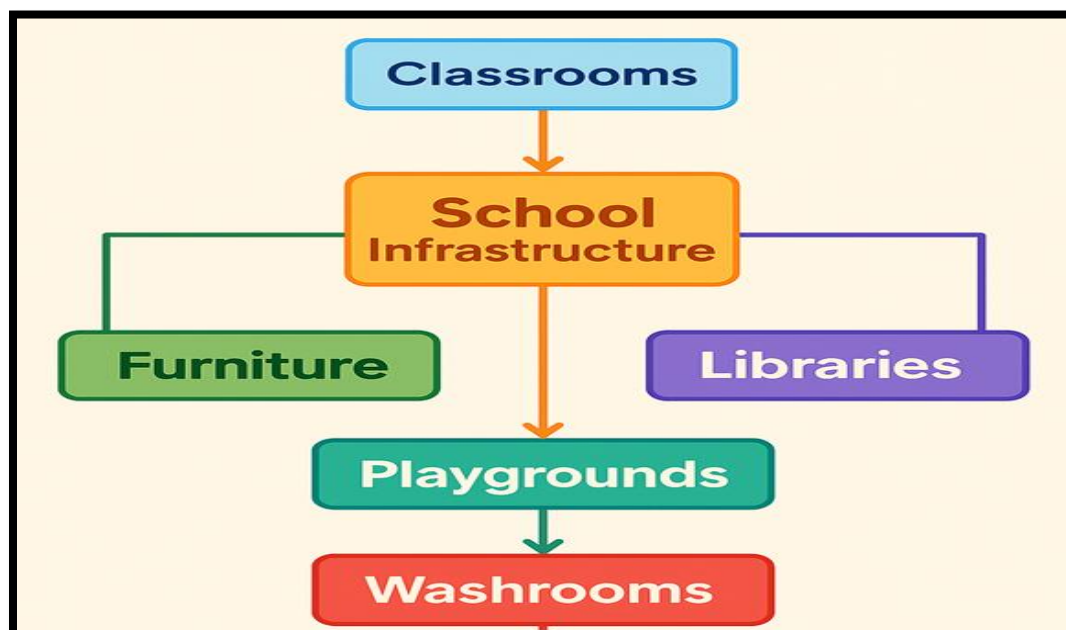


Figure 1: Key elements of school infrastructure, including Classrooms, Libraries, Laboratories, Playgrounds, Washrooms, and Furniture.

Methodology

Research methodology is the part of the research study in which researchers give an account of the research methods, which they have used to conduct their research (Rao et al., 2023; Ahmad et al., 2025; Somoro et al., 2025, Yousaf et al., 2025).

Research Design

“Design of the research comprises of the whole procedure which is conducted research” (Ahmad et al., 2022). A descriptive survey design, incorporating both quantitative and qualitative elements, was employed in this study, utilizing a qualitative explanatory sequential mixed-methods approach. This design involved the collection and analysis of both quantitative and qualitative data. The quantitative phase of the study involved measuring the perceptions of principals, subject specialists, and students, while the qualitative phase involved conducting interviews to explain or expand on the findings of the quantitative phase.

Population and Sampling

The target population consisted of stakeholders from all higher secondary schools in Tehsil Rahim Yar Khan. Using a cluster random sampling technique, a representative sample was drawn, including:

- **Principals/head teachers:** 20
- **Subject Specialists:** 40
- **Students (Intermediate level):** 200

The sample covered **both urban and rural** institutions, with 10 schools from each setting to capture environmental and infrastructural variation

Research Instruments

Three instruments were created and tested for validity.

1. Questionnaire: Designed around major dimensions including classroom conditions, libraries, laboratories, sanitation, safety, and co-curricular facilities. The responses were captured using a five-point Likert scale.

2. Interview Guide: Semi-structured interviews were conducted with teachers and principals to understand their experiences with the quality of infrastructure and how it may affect student motivation.
3. Observation Checklist: To be used for noting down the physical infrastructure, availability of resources, and safety standards in the chosen schools.

Pilot Testing and Validity

The tools were piloted in one school to ensure their clarity, reliability, and internal consistency. Expert feedback was sought to refine the wording of the item and optimize the scale distribution. Cronbach's alpha and inter-rater agreement were used to ascertain the reliability of both quantitative and qualitative measurements.

Procedures for data collection

Data was collected in three phases:

1. Questionnaires were administered to students, teachers, and principals.
2. Semi-structured interviews and focus groups were conducted to supplement the quantitative data.
3. School facilities were observed using the checklist to triangulate self-reported data.

Data Analysis

Quantitative data were analyzed using SPSS for both descriptive (means, standard deviations, frequencies) and inferential statistics (correlation and regression tests). Qualitative responses were coded thematically to identify recurring perceptions and provide contextual explanations for the quantitative trend.

Variables

- Independent Variable: School Infrastructure
- Dependent Variables: Students' Academic Performance and Social Skills
- Control Variables: Socioeconomic status, school type, teacher-student ratio

Results and Discussion

The purpose of this section is to present and interpret the findings regarding how various dimensions of school infrastructure affect students' academic performance and social skill development in higher-secondary schools of Rahim Yar Khan, Pakistan. Quantitative data from 260 respondents (20 principals, 40 teachers, 200 students) were complemented by qualitative insights from interviews and on-site observations. Tables 1 to 5 summarize the aggregated outcomes across five thematic dimensions: (1) Learning Resources, (2) Sanitation and Safety, (3) Co-curricular and Recreational Spaces, (4) Inclusive Infrastructure, and (5) Teacher–Student Interaction.

Learning Resources and Academic Performance

Table 1. Perceived adequacy of core learning resources

Variable	Mean (\pmSD)	Agreement %
Library access and book availability	4.23 \pm 0.64	86 %
functionality of science laboratories	4.12 \pm 0.71	84 %
Classroom furniture and ventilation	4.34 \pm 0.57	89 %
ICT/computer lab availability	3.98 \pm 0.79	78 %

A large majority of the respondents agreed that students' concentration and understanding of concepts are better in well-stocked libraries, functional laboratories, and ventilated classrooms. Correlation analysis revealed a statistically significant positive correlation ($r = 0.61$, $p < 0.01$) between learning resources and achievement scores. The results align with those of international studies, indicating that physical conditions account for 10–6% of the variance in academic performance. The excerpts from the interviews indicate that laboratory upgrades were associated with inquiry-based learning, which aligns with Punjab's previous Science Laboratory Renovation Project, which showed an improvement in the pass rate of 10–12% (13).

Sanitation, Safety, and Well-being

Table 2. Sanitation and safety conditions and perceived behavioral outcomes

Variable	Mean (\pm SD)	Agreement %
Clean washrooms and potable water	4.28 \pm 0.69	Reduced absenteeism (-12 %)
Waste disposal and hygiene practices	4.09 \pm 0.73	Improved participation (+9 %)
Safety equipment (fire, CCTV, guards)	4.31 \pm 0.62	Decreased conflicts (-15 %)
Structural soundness and ventilation	4.26 \pm 0.68	Greater comfort (+11 %)

The safety and adequacy of sanitation facilities, as well as structural conditions, were reported to improve school attendance. Enrolment, especially among girls, increased due to heightened safety and inclusion, as reported in qualitative responses. This aligns with studies conducted in Pakistan and Sub-Saharan Africa, which show that the addition of sanitation and safety facilities and measures has a direct and positive correlation with enrolment and gender equality. A qualitative review of responses found that maintaining a clean environment fostered respect for shared spaces and instilled discipline, a valuable lesson in civility.

Co-curricular and Recreational Facilities

Table 3. Role of activity spaces in social-emotional learning

Variable	Mean (\pm SD)	Agreement %
Playgrounds and sports fields	4.05 \pm 0.75	Teamwork & resilience
Auditorium/event area	3.94 \pm 0.81	Confidence in public speaking
Clubs/art rooms	3.89 \pm 0.77	Creativity and self-expression
Morning assemblies	4.22 \pm 0.66	Sense of belonging and unity

In general, over 80% of our respondents identified spaces where extracurricular activities took place as playing a significant role in developing leadership and communication skills. Regression analysis further substantiated that schools that maintained playgrounds and routinely organized co-curricular activities had significantly higher mean social-skill scores ($\beta = 0.48$, $p < 0.05$). This supports the literature, which has found that the psychosocial environment, rather than solely academics, is fundamental to positive education outcomes.

Inclusive Infrastructure and Equity

Table 4. Infrastructure inclusivity and empathy indicators

Feature	Mean (\pm SD)	Student perception
Ramps & accessible paths	3.76 \pm 0.83	Equal participation for disabled peers
Gender-segregated washrooms	4.18 \pm 0.69	Enhanced privacy and comfort
Resource equity (rural vs urban)	3.52 \pm 0.92	Persistent gap perceived
Culturally responsive design	3.98 \pm 0.72	Improved empathy and respect

Accessibility features are limited in rural schools. However, participants linked inclusive facilities to increased empathy, less discrimination, and stronger peer bonding. This corroborates international findings that equitable environments bolster social cohesion and reduce dropout rates among marginalized students. The study thus emphasizes infrastructure equity as a moral and pedagogical imperative.

Teacher-Student Interaction and School Climate

Table 5. Infrastructure support for pedagogical interaction

Aspect	Mean (\pm SD)	Qualitative theme
Classroom space enabling group work	4.36 \pm 0.58	Interactive teaching possible
Acoustics & lighting	4.29 \pm 0.61	Improved attention span
Staffrooms and meeting spaces	3.97 \pm 0.80	Collaborative culture among teachers
Digital tools (projectors, Wi-Fi)	3.83 \pm 0.82	Technology-supported instruction

Availability of space and proper lighting also strongly facilitated teacher-student communication ($r = 0.54$, $p < 0.01$). Teachers specifically noted that modernized classrooms also facilitate participatory approaches, e.g., group discussions, presentations, and peer assessment, which in turn promote better critical thinking skills. This result is in line with multilevel analyses that find the presence of libraries, labs, and connectivity as one of the strongest predictors of learning outcomes.

Integrated Interpretation

Taken together, data from all sectors showed a positive correlation between the quality of school infrastructure and academic and social outcomes. Schools that ranked 4.0 or higher in the composite infrastructure score had:

- Higher average academic performance (+8-12 %)
- Less absenteeism (-10-15 %)
- Better peer cooperation and classroom management

Qualitative stories also confirmed that children define "good schools" as those with both good teaching and safe, clean, and motivating physical spaces. These results confirm global evidence that investments in school infrastructure have measurable educational benefits, and justify demand for long-term, equity-focused planning rather than ad hoc refurbishment.

Summary of Key Insights

1. Infrastructure Quality is a Strong Predictor of Use and Learning Outcomes: Exam scores and attendance performance were significantly predicted by the physical quality of the schools.
2. Infrastructure Quality and Gender-Responsive Design Impact Female Participation: Confidence and attendance were higher in girls with access to secure, private sanitation facilities.
3. Co-curricular Activities Help in Enhancing Socio-emotional Skills: Leadership and emotional intelligence were enhanced by programs encouraging participation and engagement in extracurricular activities.

4. Overall, Girls had Access to Equal Infrastructure Facilities as Boys: The level of infrastructure facilities was similar in schools for both girls and boys.
5. The Level of Infrastructure Facilities was Unequal among Urban and Rural Areas: Schools in rural areas were relatively lacking in ICT and accessibility infrastructure facilities.

Conclusion and Policy Implications

The current research investigated the relationship between school infrastructure and the academic performance and social skills of higher secondary students in Rahim Yar Khan, Pakistan. The collected data from principals, teachers, and students serve as evidence, and the inferences reveal that the quality, availability, and accessibility of the physical learning environment are critical factors for both the academic and social-emotional development of students. The current study clearly indicates that infrastructure is not an add-on or precondition but an integral part of the teaching and learning process.

Synthesis of Key Findings

Thematic areas, including learning materials, hygiene and safety, co-curricular and extracurricular amenities, accessibility, and teacher-student interaction, have a significant impact on student development and academic progress.

In the current research, the schools that had composite infrastructure scores of more than 4.0 (on a scale of 5):

- 8–12 % increased internal assessment scores
- 10–15 % reduction in absenteeism, especially in female students
- Significant improvement in team spirit, empathy, and communication skills.

Qualitative analysis also reveals that students consider a clean, green, and well-equipped physical learning environment as a safe, inspiring, and dignified place, where they feel motivated and belong. Teachers also mentioned that well-equipped classrooms and labs enabled them to adopt interactive teaching and ensured continuous engagement with the learners.

Alignment with Global Evidence and SDG

These findings are consistent with global studies, which show that physical infrastructure explains as much as 16% of the variation in student outcomes. In relation to the UN Sustainable Development Goal 4, “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all,” the study underlines 3 key areas:

1. **Equity:** Inequities between urban and rural schools in resource endowment are a direct reflection of social inequities that must be redressed through compensatory funding.
2. **Quality:** Learner enrollment is just the start. The quality of facilities will determine if learning spaces enable critical thinking and innovation.
3. **Inclusivity:** Gender responsive and disability friendly design is what turns infrastructure from a physical resource into a social leveler.

Policy and Practice Recommendations

1. Prioritize Infrastructure Equity

Investment in school infrastructure must be guided by equity principles, with financial resources targeting schools with the greatest needs. Redirecting funds to students rather than to regions based on population can generate the biggest gains in learning.

2. Integrate Pedagogical Renewal

Infrastructure investment must be accompanied by teacher training on new, active, and student-centered teaching methodologies, so that, for instance, new science labs and ICT facilities are

effectively utilized to enhance teaching and learning.

3. **Institutionalizing Maintenance Program**

Maintenance is key for schools to last long term. Allocation of maintenance budgets, school facility audits, and multi-stakeholder partnerships can help protect schools from deterioration and enhance the quality of their infrastructure.

4. **Design for Health, Safety, and Climate Resilience.**

Designing for optimal health and safety conditions, including air and noise quality, natural lighting, and ventilation, will also enhance learning. Climate-proof design and integrating nature into and around school buildings and renewable-energy systems can lower the environmental impact and reduce energy and maintenance costs

5. **Foster Community Participation**

The involvement of students and parents in the design and maintenance of school facilities creates a sense of ownership that can reduce the incidence of vandalism and facilitate the integration of cultural specifics.

6. **Leverage Digital Infrastructure**

Internet access and a functioning computer lab can provide access to the world's knowledge for students and connect schools to global education networks.

Limitations and Future Research

The main limitation of the study is that it only included a single district and was not based on actual testing, but rather on self-reported perceptions, although observations were also used. Follow-up studies could utilize longitudinal or multilevel modeling at the provincial level to measure the share of infrastructure in the standardized scores, while controlling for teacher quality, curriculum design, and socioeconomic conditions. They could also include post-COVID digital learning variables, which would demonstrate how mixed infrastructures comprising both physical and virtual elements are influencing outcomes in a hybrid system.

Concluding Remark

Spaces that dignify the learning process: Equity in education starts with. When we invest in environments that inspire curiosity, safety, and empathy, and not just buildings, we advance towards achieving SDG 4 and generations of learners who will build resilient, equitable communities in Pakistan.

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