Journal of Engineering Issues and Solutions

Evaluating Effective Informal Spaces in Schools through Spatial Design Factors and Student Experiences: "Case in Kathmandu Valley"

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Received: November 25, 2025; Revised: 27 January, 2026; Accepted: March 21, 2026

Abstract

In our educational process, learner-centered cooperation is taking the place of teacher-centered learning. Students spend a significant portion of the day in "informal spaces" (IS) such the corridor, lobby, hall, canteen, patio, and stairway, even though conventional classrooms serve as the primary setting for instruction. Outside of traditional classroom settings, schools' informal interior spaces are crucial for fostering social interaction, independent study, and overall student wellbeing. In terms of how they enhance the student experience, engagement, and sense of belonging, they are significant but little-researched areas. Despite the fact that these spaces can have significant effects on students' emotional affinity and connection to their educational environment, they are comparatively understudied in the Nepali school system.

This study evaluates the effectiveness of such spaces at two selected secondary schools in the Based on spatial design elements and student experiences, this study employs a mixed-methods approach that includes site inspections, behavioral mapping, focus groups, area measures, and student questionnaires to assess the effectiveness of such spaces at two selected secondary schools in the Kathmandu Valley. About 22–28% of the interior space is dedicated to the main areas for informal activities: the lobby, library nooks, stairs, and hallway.

Students think these spaces are good for social interaction, but they also point out that there aren't enough safety lighting or acoustics. Flexible seating areas, more natural daylighting, and strategic placement near popular areas are recommended design needs to optimize future school designs in Nepal.

Keywords: *Informal spaces, School Architecture, Spatial Designs, Student Experiences, Kathmandu Valley.*

1. Introduction

Schools serve as social and emotional ecosystems where students create identities, connections, and a sense of belonging in addition to being formal learning environments. Modern educational research highlights

the value of informal learning spaces (ILS), such as hallways, courtyards, library corners, open study areas, transitional zones, and semi-outdoor social spaces, as crucial supplements to formal instruction, even though the classroom has historically been seen as the primary academic space(Wu et al., 2021a). These spaces support **self-directed learning, peer collaboration, and social interaction**, making them integral contributors to students' holistic development(Beery et al., 2013). Goodenow (1993) argues that environments that support belonging enhance students' confidence and engagement, whereas environments lacking such support can contribute to alienation and disengagement. Belonging is partially shaped by spatial experience, the built environment becomes a critical factor in student outcomes. Architectural features such as spatial openness, accessibility, furniture flexibility, lighting quality, and opportunities for informal gathering significantly influence how students use and perceive school spaces(Barrett et al., 2013). Contemporary educational theory recognizes that learning extends beyond formal classroom settings and occurs through social interaction, peer discussion, and self-directed engagement(Fouad & Sailer, 2019). However, these spaces are often designed primarily for circulation rather than for learning or interaction. Research on informal learning environments suggests that spatial characteristics such as comfort, flexibility, openness, and support facilities significantly influence user behavior and engagement(Wu et al., 2021b).

This research examines two representative secondary schools: Patan Secondary School (recently reconstructed with international support) and Laboratory School. Both serve diverse student populations in densely built valley settings. Bringing this to our context: In Kathmandu, land is expensive. Schools are growing vertically. We often see the 'Concrete Box' design where corridors are strictly for movement. As outdoor playgrounds shrink, these indoor informal spaces become the only places for students to socialize. Currently, these spaces are failing our students. The main researThis research examines two representative secondary schools: Patan Secondary School (recently reconstructed with international support) and Laboratory School (Kirtipur). Both serve diverse student populations in densely built valley settings. The main research question is: What spatial design factors and student experiences determine the success of informal interior spaces in secondary schools? Sub-questions address types of spaces, usage patterns, influencing characteristics, space proportions, activity hotspots, student perceptions, and design recommendations quest formal spaces become the only places for students to socialize. Currently, these spaces are failing our students. Contemporary educational theory recognizes that learning extends beyond formal classroom settings and occurs through social interaction, peer discussion, and self-directed engagement(Fouad & Sailer, 2019). The study examines interior areas such as corridors, Staircases and landings, lobby and entrance spaces, library informal zones and spatial analysis on area measurement formal vs informal space proportion spatial configuration, accessibility and visibility.

Spatial Typologies of Space and Characteristics of Design

Various kinds of informal spaces are identified by research according to enclosure, user group, and activity:

- Quiet, private areas inside for concentrated study
- Interiors that are semi-private and semi-public for working in small groups
- Larger social contacts are supported by public indoor and semi-outdoor areas.
- Public outdoor spaces and all-inclusive, multipurpose spaces

These typologies show how visual connectedness, closeness to formal zones, and spatial arrangement (open vs. enclosed, indoor vs. outdoor) affect informal learning behavior(Salih et al., 2024). A significant theme in literature is the influence of **spatial design characteristics** on how students use and perceive informal learning environments.

Spatial Design Characteristics Influencing Informal space use

Wu et al. (2021) identify six key design features of informal learning spaces that shape student preferences and activity patterns:

- Flexibility and comfort (movable furniture, seating options)
- Adaptability and functionality
- Space's openness and hierarchy
- Support facilities

For instance, interior corridors in schools have been shown to function beyond circulation routes, potentially triggering social interaction and student engagement when configured with adequate spatial capacity and accessibility (UCL Discovery, 2019).

Spatial Role of Informal Learning Spaces

According to research on school architecture, students' behavior and participation are influenced by informal settings in ways that conventional classrooms cannot. These areas permit:

- peer conversation
- collaborative knowledge generation
- reflection and relaxation
- cross-generational learning exchanges

Research conducted outside of Nepal demonstrates that comfortable, well-connected, and aesthetically pleasing hallways, lounge areas, and informal gathering places serve as learning incubators

Student Perspectives on Informal Learning beyond Formal Classrooms

Trends in learning space design now emphasize human-centered approaches, recognizing that learning extends beyond the temporal and spatial boundaries of the classroom (Educause, 2024). This holistic perspective supports the view that student engagement, creativity, and collaboration are enriched when learning environments incorporate flexible and diverse spatial contexts. Traditional architectural features like courtyards and verandas have historically served as social and informal learning areas in Nepal, providing climate comfort and opportunities for social interaction(Kandel et al., 2024).

Quantification of Formal and Informal Spaces in Proportion

Current research highlights the significance of informal spaces' spatial distribution and proportion as opposed to their sheer presence. According to (Tanner, 2009), high-achieving schools should devote 20–30% of their total built-up area to social and non-classroom learning areas.

Calculating the area percentage of formal and informal spaces in relation to a school's total built-up area is known as proportional quantification. By using this technique, academics and architects can compare spatial priorities across various school typologies in an objective manner(Lipmann, 2010).

$$\text{Formal Space Ratio (\%)} = \frac{\text{Total Formal Learning Area}}{\text{Total Built-Up Area}} \times 100$$

$$\text{Informal Space Ratio (\%)} = \frac{\text{Total Informal Learning Area}}{\text{Total Built-Up Area}} \times 100$$

Formula:

This quantitative method aids in determining if a school's layout promotes holistic learning or maintains classroom dominance.

According to international surveys, formal classrooms occupy 70–80% of the learning-related space in traditional institutions, leaving little room for informal learning(Secretary General Organization for Economic Co-operation and Development, 2011). However, more equitable distribution is advised by modern learning environment models:

- 55–65% of learning spaces are formal.
- 25–35% of learning spaces are informal.
- Service/Support Spaces: 10–15%

Space Syntax research Bill & Julienne (1984), demonstrates that increased spatial integration of informal spaces improves:

- movement patterns,
- social interaction,
- Visibility and safety.

Informal Learning Spaces' Spatial Distance and Accessibility to Classrooms

The efficiency of informal learning spaces is heavily impacted by their spatial closeness to classrooms, according to design guidelines and standards for educational facilities. Informal spaces are more commonly used and more successfully incorporated into regular learning routines when they are physically and visually adjacent to formal learning venues(Dudek, 2012).

Table 1: Spatial Proximity Design Criteria for Informal Learning Space

Design Parameter	Recommended Metric	Source	Design Implication for Schools
Distance from classroom	5–15 m walking distance	Tanner (2009)	Encourages spontaneous and frequent use
Visual connection	Direct line of sight / partial transparency	Dudek (2000)	Enhances safety and perceived accessibility
Adjacency	Directly connected to classroom clusters	OECD (2017)	Integrates informal learning into daily routines
Spatial depth	1–2 spatial steps from classrooms	Hillier & Hanson (1984)	Higher interaction probability
Location	Along main circulation routes	Neufert (2012)	Converts corridors into learning zones
Integration value	High spatial integration relative to classrooms	Hillier & Hanson (1984)	Promotes social interaction and movement

Informal Learning Spaces and Student Belonging

The concept of "student belonging" describes how students feel about their educational environment, which

is influenced by identification, safety, social interaction, and spatial comfort(Goodenow, 1993).

According to Korpershoek et al. (2020), there is a strong correlation between belonging and:

- availability of social areas
- potential for informal interaction
- perceived ownership of space

From an architectural perspective, areas that promote loitering, personalizing, and peer interaction significantly enhance users' sense of belonging(Francis et al., 2012).

2. Materials and Methods

2.2 Methodological framework

This study adopts a mixed-methods multiple case study design. A mixed-methods approach integrates quantitative and qualitative data collection and analysis to provide a comprehensive understanding of the research problem not just what spatial patterns exist but **why** and **how** they relate to students' experiences and sense of belonging. The design uses convergent mixed methods, where both quantitative and qualitative strands are collected in parallel and interpreted together.

A **multiple case study strategy** is chosen because it allows detailed investigation of contemporary real-world phenomena informal learning spaces within actual school contexts. A case study is suitable where boundary between phenomenon and context is not clearly defined, and it enables triangulation across multiple data sources for validity.

- **Spatial Analysis:**

Floor plans were measured on-site (using laser tools and AutoCAD) to calculate formal (classrooms, labs) vs. informal (corridors, cafeterias, etc.) area proportions. Behavioral mapping tracked student activities over three full school days.

- **Student Experiences**:

Structured questionnaires (Likert-scale 1–5 on comfort, safety, social interaction) were administered to 40 students per school (grades 6–12, stratified random sampling). Focus-group discussions (n=4 groups) explored qualitative perceptions.

- **Ethical Considerations**:

Permissions obtained from school authorities; participant consent and anonymity ensured.

- **Data Analysis**:

Quantitative data via SPSS (descriptive statistics, correlations); qualitative via thematic coding.

3. Case Study Are

3.1 Patan Secondary School

The reconstruction of Patan Secondary School, located in Lalitpur, Nepal, was completed under Japan's Emergency School Reconstruction Project (ESRP), which aimed to rebuild schools damaged by the 2015

Gorkha earthquake. The newly reconstructed buildings will comprise of 3 new blocks (4 storey blocks with 28 classrooms, 3 storey blocks with administration offices including library and science laboratory and 2 storey toilet blocks) and retrofitting of existing assembly hall. The new school buildings are fully equipped with furniture and are constructed with multihazard resilient structures which are environment, child, gender and disable friendly and is expected to provide improved learning environment for the students.

3.2 Laboratory School

One of the most important instances of contemporary institutional architecture in Nepal is the Laboratory School in Kirtipur, which was created in 1965 by American architect Benjamin Polk. The school was designed as a living laboratory for learning, pedagogy, and spatial experimentation in addition to being a venue for instruction. It was built as part of an educational infrastructure initiative funded by USAID.

The school is arranged with courtyards and semi-open circulation areas in a low-rise, horizontally dispersed form. The campus is divided into linear classroom blocks structured to generate covered outdoor areas rather than being cramped or vertical.

4. Data Collection and Analysis

4.1 Site Observations

- **Formal learning spaces** (classrooms, laboratories, administration) are enclosed and structured.
- **Informal learning spaces** (verandahs, corridors, courtyards) are open, shaded, and visually connected.

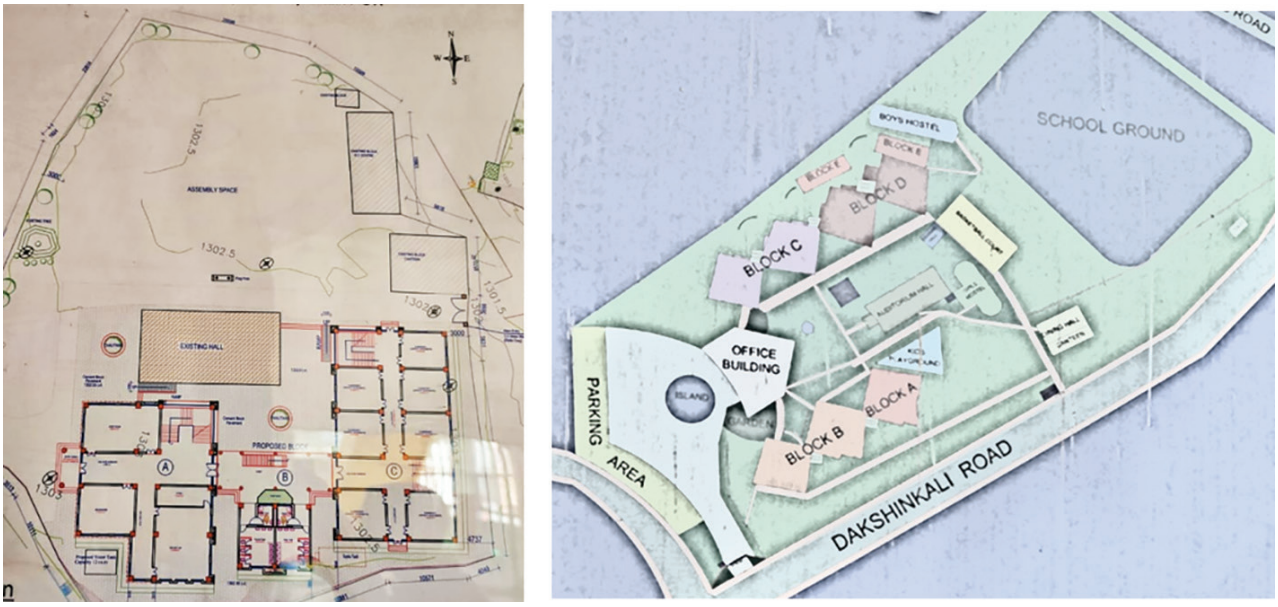
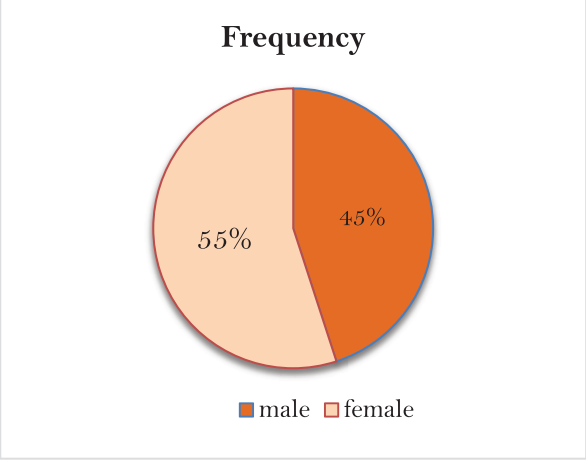


Figure 1: Master Plan of Patan School (Left) and Laboratory School (Right)

4.2 Analyzing Demographical Data

Patan High School



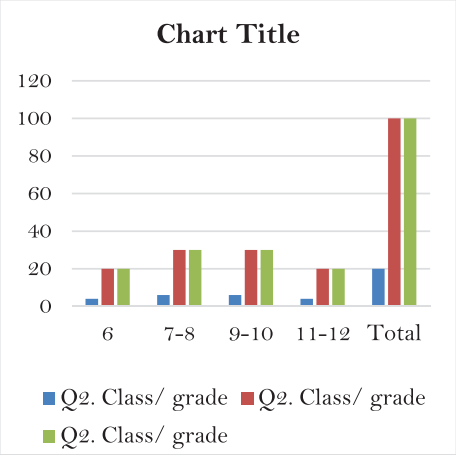
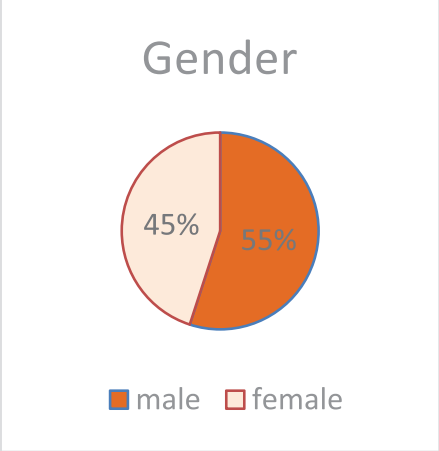


Table 2: Demographi Data of Patan School

Q2. Class/ grade					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	4	20.0	20.0	20.0
	7-8	6	30.0	30.0	50.0
	9-10	6	30.0	30.0	80.0
	11-12	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

Laboratory Secondary School



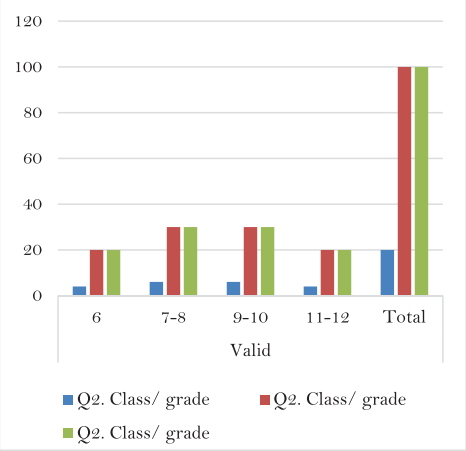


Table 3: Demographi Data of Laboratory School

Q2. Class/ grade

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	4	20.0	20.0	20.0
	7-8	6	30.0	30.0	50.0
	9-10	6	30.0	30.0	80.0
	11-12	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

Q3. Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	11	55.0	55.0	55.0
	female	9	45.0	45.0	100.0
	Total	20	100.0	100.0	

In Patan Higher School, 55% of respondents were female, while in Laboratory School, 55% were male

4.3 Type of Informal Space Usage

Use corridor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	10	50.0	50.0	50.0
	Selected	10	50.0	50.0	100.0
	Total	20	100.0	100.0	

Use staircase landing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	12	60.0	60.0	60.0
	Selected	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Use of lobby/hall

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	9	45.0	45.0	45.0
	Selected	11	55.0	55.0	100.0
	Total	20	100.0	100.0	

Use of outside classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	11	35.0	35.0	35.0
	Selected	9	65.0	65.0	100.0
	Total	20	100.0	100.0	

Use of library spill

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	12	60.0	60.0	60.0
	Selected	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Use of under staircase

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	14	70.0	70.0	70.0
	Selected	6	30.0	30.0	100.0
	Total	20	100.0	100.0	

Use of courtyard

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	7	35.0	65.0	65.0
	Selected	13	65.0	35.0	100.0
	Total	20	100.0	100.0	

Table 4: Type of Informal Space Use in Patan School

In Patan School, courtyard were the most frequently used informal spaces (65%).

Laboratory Secondary School

Table 5: Type of Informal Space Use in Laboratory School

Use corridor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	30.0	30.0	30.0
	Selected	8	40.0	70.0	100.0
	Total	20	100.0	100.0	

Use staircase landing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	18	90.0	90.0	90.0
	Selected	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

Use of lobby/hall

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	12	60.0	60.0	60.0
	Selected	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Use of outside classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	10.0	10.0	10.0
	Selected	18	90.0	90.0	100.0
	Total	20	100.0	100.0	

Use of library spill

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	10	50.0	50.0	50.0
	Selected	10	50.0	50.0	100.0
	Total	20	100.0	100.0	

Use of under staircase

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	20	100.0	100.0	100.0

Use of courtyard

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	13	65.0	65.0	65.0
	Selected	7	35.0	35.0	100.0
	Total	20	100.0	100.0	

In Laboratory School, outside the classroom were the most frequently used informal spaces.

4.4 Frequency of Informal Space Use in School

Figure 2: Frequency of use of informal space

This clearly shows that more than 90% of students in both schools frequently engage with informal learning spaces, demonstrating their importance in daily school life.

4.5 Time use of informal space

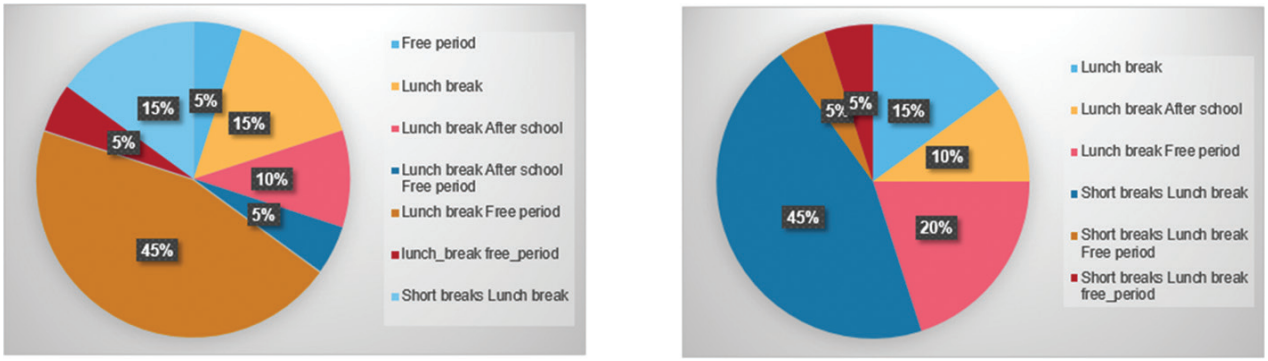


Figure 3: Time period of use of informal space

The data clearly indicates that lunch break is the dominant time for informal space usage in Patan High School, with nearly half (45%) of students using spaces during this period. In Laboratory School, usage is more distributed across multiple time slots. The highest percentage (45%) indicates students use informal spaces during **short breaks combined with lunch break**

4.6 Activity to Do in Informal Space

Patan High School

Table 6: Type of activities in informal space use in

For taking with friends

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	20.0	20.0	20.0
	Selected	16	80.0	80.0	100.0
	Total	20	100.0	100.0	

For eating snacks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	19	95.0	95.0	95.0
	Selected	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

For study/ homework

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	14	70.0	70.0	70.0
	Selected	6	30.0	30.0	100.0
	Total	20	100.0	100.0	

For group discussion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	17	85.0	85.0	85.0
	Selected	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

For resting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	25.0	25.0	25.0
	Selected	15	75.0	75.0	100.0
	Total	20	100.0	100.0	

For playing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	11	55.0	55.0	55.0
	Selected	9	45.0	45.0	100.0
	Total	20	100.0	100.0	

Patan School

In school, talking 80%) and resting (75%) playing (45%) were the most frequent activities observed in informal spaces. Studying behavior was relatively low (30%), indicating that students primarily used these spaces for

social interaction rather than academic engagement.

Laboratory Secondary School

Table 7: Type of activities in informal space use in

For taking with friends

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	7	35.0	35.0	35.0
	Selected	13	65.0	65.0	100.0
	Total	20	100.0	100.0	

For eating snacks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	15	75.0	75.0	75.0
	Selected	5	25.0	25.0	100.0
	Total	20	100.0	100.0	

For study/ homework

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	11	55.0	50.0	50.0
	Selected	9	45.0	50.0	100.0
	Total	20	100.0	100.0	

For group discussion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	16	80.0	80.0	80.0
	Selected	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

For resting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	30.0	30.0	30.0
	Selected	14	70.0	70.0	100.0
	Total	20	100.0	100.0	

For playing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	11	55.0	55.0	55.0
	Selected	9	45.0	45.0	100.0

Laboratory School

In this school, resting (70%), talking (65%) and playing (45%) were the most frequent activities observed in informal spaces. Studying behavior was relatively low (45%), indicating that students primarily used these spaces for social interaction rather than academic engagement.

4.7 Reason of Informal Space Use

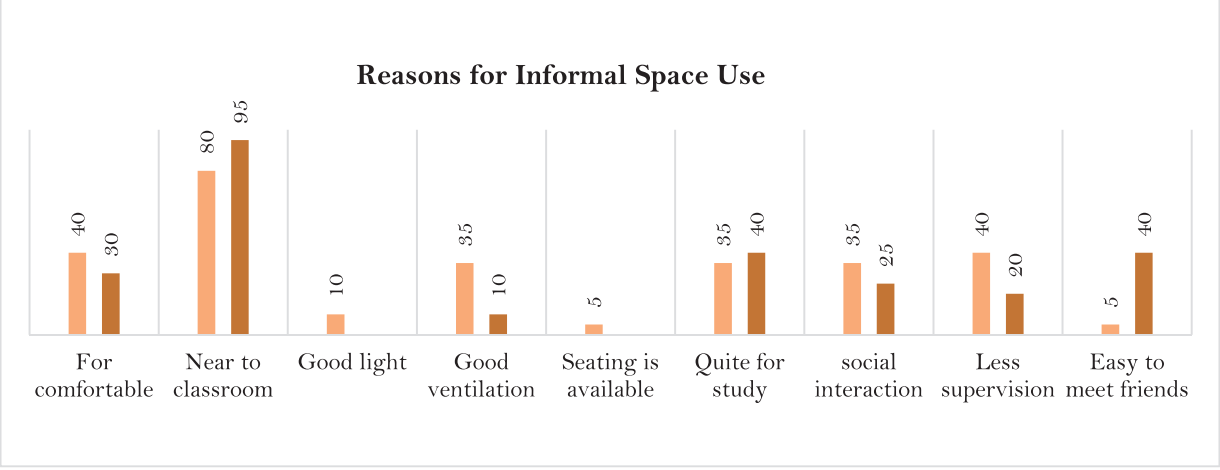


Figure 4: Different region use of informal space

4.8 Perception Analysis

Patan High School

Table 8: Positive perceptions regarding accessibility, social interaction, and safety, environmental comfort factors consistently received lower ratings across Patan schools.

Dimension	No. of Items	Mean (M)	Std. Deviation (Approx.)	Interpretation
Comfort & Environmental Quality	5	3.46	0.61	Moderate–Positive
Seating & Physical Facilities	4	3.53	0.53	Moderate Positive
Accessibility & Location	4	4.48	0.51	Very Positive
Social Interaction & Belonging	4	4.25	0.55	Very Positive
Safety & Comfort	4	4.19	0.49	Positive–High
Preference & Choice	7	4.19	0.64	Positive–High

Social Interaction & Belonging (M = 4.25). Comfort & Environmental Quality, on the other hand, had the lowest mean (M = 3.46), primarily due to worries about noise levels and crowding. Overall, the results indicate that although informal spaces successfully facilitate accessibility, engagement, and student preference, they still require enhancements in terms of spatial circumstances and environmental comfort.

Laboratory Secondary School

Table 9: Positive perceptions regarding accessibility, social interaction, and safety, environmental comfort factors consistently received lower ratings across Laboratory schools.

Dimension	No. of Items	Mean (M)	Std. Deviation (SD)	Interpretation
Comfort & Environmental Quality	5	3.56	0.46	Moderate
Seating & Physical Facilities	4	3.51	0.57	Moderate
Accessibility & Location	4	4.48	0.49	Very Positive
Social Interaction & Belonging	4	4.29	0.47	Very Positive
Safety & Comfort	4	4.28	0.43	Very Positive
Preference & Choice	7	4.29	0.62	Very Positive

4.9 Correlation Analysis

Patan High School

A. Spatial Comfort & Physical Experience

- Comfort & Environmental Quality

Table 10: Correlation of spatial comfort and physical experience Patan Schools

Correlation						
		The informal spaces are comfortable to stay in.	**There is enough natural light in these spaces.**	**Ventilation and air quality are good.**	**Noise levels are acceptable.**	**The space is not overcrowded.**
The informal spaces are comfortable to stay in.	Pearson Correlation	1	.014	.058	.141	.170
	Sig. (2-tailed)		.954	.807	.553	.472
	N	20	20	20	20	20
There is enough natural light in these spaces.	Pearson Correlation	.014	1	.495*	.533*	.570**
	Sig. (2-tailed)	.954		.027	.016	.009
	N	20	20	20	20	20
Ventilation and air quality are good.	Pearson Correlation	.058	.495*	1	.180	.311
	Sig. (2-tailed)	.807	.027		.449	.182
	N	20	20	20	20	20
Noise levels are acceptable.	Pearson Correlation	.141	.533*	.180	1	.564**
	Sig. (2-tailed)	.553	.016	.449		.010
	N	20	20	20	20	20
The space is not overcrowded.	Pearson Correlation	.170	.570**	.311	.564**	1
	Sig. (2-tailed)	.472	.009	.182	.010	
	N	20	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

- Seating & Physical Facilities

Table 11: Correlation of spatial comfort and physical experience Patan Schools

Correlations					
		Seating is available in informal spaces.	**I can sit comfortably even without formal furniture.**	**There are edges, steps, or surfaces suitable for informal seating.**	**The spaces allow flexible movement and use.**
Seating is available in informal spaces.	Pearson Correlation	1	.316	.333	.313
	Sig. (2-tailed)		.175	.151	.179
	N	20	20	20	20
I can sit comfortably even without formal furniture.	Pearson Correlation	.316	1	.379	.392
	Sig. (2-tailed)	.175		.099	.087
	N	20	20	20	20
There are edges, steps, or surfaces suitable for informal seating.	Pearson Correlation	.333	.379	1	.313
	Sig. (2-tailed)	.151	.099		.179
	N	20	20	20	20
The spaces allow flexible movement and use.	Pearson Correlation	.313	.392	.313	1
	Sig. (2-tailed)	.179	.087	.179	
	N	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

- Accessibility & Location

Table 12: Correlation of spatial comfort and physical experience Patan Schools

Correlations					
		Informal spaces are located close to classrooms.	**These spaces are easy to access.**	**Circulation spaces naturally become social areas.**	**These spaces are visually open.**
Informal spaces are located close to classrooms.	Pearson Correlation	1	.471*	-.471*	.073
	Sig. (2-tailed)		.036	.036	.759
	N	20	20	20	20
These spaces are easy to access.	Pearson Correlation	.471*	1	-.121	.019
	Sig. (2-tailed)	.036		.612	.937
	N	20	20	20	20
Circulation spaces naturally become social areas.	Pearson Correlation	-.471*	-.121	1	.358
	Sig. (2-tailed)	.036	.612		.121
	N	20	20	20	20
These spaces are visually open.	Pearson Correlation	.073	.019	.358	1
	Sig. (2-tailed)	.759	.937	.121	
	N	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

B. Emotional & Behavioral Experience

- Social Interaction & Belonging
- Safety & Comfort
- Preference & Choice

Significant relationships were observed between natural lighting, acceptable noise levels, and perceptions of crowding, indicating that environmental conditions influence spatial comfort collectively. Accessibility variables such as proximity to classrooms and ease of access showed positive correlations, reinforcing the importance of location in shaping student experience.

Seating and physical facility variables showed weak correlations, suggesting that spatial flexibility and openness may be more important than formal furniture provision

Laboratory Secondary School

A. Spatial Comfort & Physical Experience

Table 13: Correlation of spatial comfort and physical experience Laboratory Schools

Correlations						
		The informal spaces are comfortable to stay in.	**There is enough natural light in these spaces.**	**Ventilation and air quality are good.**	**Noise levels are acceptable.**	**The space is not overcrowded.**
The informal spaces are comfortable to stay in.	Pearson Correlation	1	.258	.000	.224	.516*
	Sig. (2-tailed)		.272	1.000	.343	.020
	N	20	20	19	20	20
There is enough natural light in these spaces.	Pearson Correlation	.258	1	.683**	.115	.200
	Sig. (2-tailed)	.272		.001	.628	.398
	N	20	20	19	20	20
Ventilation and air quality are good.	Pearson Correlation	.000	.683**	1	.286	.278
	Sig. (2-tailed)	1.000	.001		.236	.250
	N	19	19	19	19	19
Noise levels are acceptable.	Pearson Correlation	.224	.115	.286	1	.577**
	Sig. (2-tailed)	.343	.628	.236		.008
	N	20	20	19	20	20
The space is not overcrowded.	Pearson Correlation	.516*	.200	.278	.577**	1
	Sig. (2-tailed)	.020	.398	.250	.008	
	N	20	20	19	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

- Comfort & Environmental Quality
- Seating & Physical Facilities

Table 14: Correlation of spatial comfort and physical experience Laboratory Schools

Correlations

		Seating is available in informal spaces.	I can sit comfortably even without formal furniture.	There are edges, steps, or surfaces suitable for informal seating.	The spaces allow flexible movement and use.
Seating is available in informal spaces.	Pearson Correlation	1	.105	.035	.112
	Sig. (2-tailed)		.658	.885	.638
	N	20	20	20	20
I can sit comfortably even without formal furniture.	Pearson Correlation	.105	1	.341	.535*
	Sig. (2-tailed)	.658		.142	.015
	N	20	20	20	20
There are edges, steps, or surfaces suitable for informal seating.	Pearson Correlation	.035	.341	1	.682**
	Sig. (2-tailed)	.885	.142		.001
	N	20	20	20	20
The spaces allow flexible movement and use.	Pearson Correlation	.112	.535*	.682**	1
	Sig. (2-tailed)	.638	.015	.001	
	N	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

- Accessibility & Location

Table 14: Correlation of spatial comfort and physical experience Laboratory Schools

Correlations

		Informal spaces are located close to classrooms.	These spaces are easy to access.	Circulation spaces naturally become social areas.	These spaces are visually open.
Informal spaces are located close to classrooms.	Pearson Correlation	1	.601**	-.471*	-.663**
	Sig. (2-tailed)		.005	.036	.001
	N	20	20	20	20
These spaces are easy to access.	Pearson Correlation	.601**	1	-.287	-.504*
	Sig. (2-tailed)	.005		.220	.023
	N	20	20	20	20
Circulation spaces naturally become social areas.	Pearson Correlation	-.471*	-.287	1	.579**
	Sig. (2-tailed)	.036	.220		.007
	N	20	20	20	20
These spaces are visually open.	Pearson Correlation	-.663**	-.504*	.579**	1
	Sig. (2-tailed)	.001	.023	.007	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

B. Emotional & Behavioral Experience

- Social Interaction & Belonging
- Safety & Comfort
- Preference & Choice

Strong correlations were observed between natural lighting and ventilation, indicating an integrated environmental comfort system. Informal seating elements were strongly associated with flexible movement patterns, suggesting that adaptable spatial features enhance usability.

Accessibility showed mixed relationships with visual openness, implying that highly open environments may sometimes reduce perceived spatial comfort or control.

4.10 Improvement Priority Analysis

Patan School

Table 15: Improvement in school for successful informal space

What improvements would you like to see in school informal spaces?		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Better lighting Quiet areas for study Better maintenance Green elements	1	5.0	5.0	5.0
	Better maintenance	1	5.0	5.0	10.0
	Better maintenance Green elements	1	5.0	5.0	15.0
	Better ventilation Quiet areas for study	1	5.0	5.0	20.0
	More seating Better lighting Better ventilation	1	5.0	5.0	25.0
	More seating Better maintenance Green elements Other	1	5.0	5.0	30.0
	More seating Better ventilation Green elements	1	5.0	5.0	35.0
	More seating Green elements Flexible furniture	1	5.0	5.0	40.0
	More seating More social spaces	1	5.0	5.0	45.0
	More seating More social spaces Better maintenance Flexible furniture	1	5.0	5.0	50.0
	More seating More social spaces Better maintenance Green elements	1	5.0	5.0	55.0
	More seating More social spaces Flexible furniture	1	5.0	5.0	60.0
	More seating Quiet areas for study Better maintenance Green elements	2	10.0	10.0	70.0
	More social spaces Better maintenance	1	5.0	5.0	75.0
	More social spaces Better safety Green elements	1	5.0	5.0	80.0
	More social spaces Flexible furniture	1	5.0	5.0	85.0
	More _seating better maintenance	1	5.0	5.0	90.0
	Quiet areas for study Better maintenance	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

Laboratory School

Table 16: Improvement in school for successful informal space

What improvements would you like to see in school informal spaces?		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	More seating	1	5.0	5.0	5.0
	More seating Better safety	1	5.0	5.0	10.0
	More seating Flexible furniture	1	5.0	5.0	15.0
	More seating More social spaces	5	25.0	25.0	40.0
	More seating Quiet areas for study	1	5.0	5.0	45.0
	More seating Quiet areas for study Better maintenance	3	15.0	15.0	60.0
	More seating Quiet areas for study More social spaces Better maintenance	1	5.0	5.0	65.0
	More seating Quiet areas for study More social spaces Better safety	1	5.0	5.0	70.0
	More seating Quiet areas for study More social spaces Green elements	1	5.0	5.0	75.0
	More social spaces	3	15.0	15.0	90.0
	Quiet areas for study	1	5.0	5.0	95.0
	Quiet areas for study More social spaces Flexible furniture	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Most requested improvement

- Seating demand %
- Quiet area demand

5. Discussion & Findings

This chapter interprets the research findings in relation to the study objectives, theoretical framework, and literature review. The discussion integrates spatial analysis, behavioral observations, and student perception survey results to understand how informal spaces (ILS) influence students' sense of belonging within Kathmandu Valley schools. Rather than presenting results alone, this chapter critically analyzes patterns, compares case study schools, and evaluates how architectural design contributes to students' emotional and social experiences.

The analysis revealed several consistent trends:

Informal learning spaces are frequently used during breaks and transitional periods.

Spaces with seating, openness, and visual connectivity showed higher occupancy.

Students reported stronger belonging in spaces that allowed social interaction and autonomy.

Spatial proximity to classrooms significantly influenced frequency of use.

Schools with intentionally designed informal spaces demonstrated higher overall belonging scores.

These findings reinforce international research that emphasizes the importance of informal spatial environments in supporting collaborative learning and emotional attachment.

a. Spatial Typology and Use Patterns

The study identified multiple informal learning space types including corridors, stair landings, courtyards, verandas, and semi-open gathering areas.

Key Observations:

- Corridor edges and stair landings were the most frequently occupied informal areas.
- Semi-outdoor courtyards supported both social and reflective activities.
- Spaces without seating or shade showed significantly lower usage levels.
- Transitional zones functioned as spontaneous interaction hubs rather than merely circulation spaces.

This confirms behavior-setting theory, which suggests that spatial configuration strongly influences patterns of human activity.

b. Architectural Attributes Influencing Belonging

Survey and observation data revealed strong relationships between architectural qualities and students' emotional responses.

Significant Attributes:

- Seating availability increased duration of stay and peer interaction.
- Natural lighting and ventilation improved comfort and perceived safety.
- Visual openness enhanced social awareness and accessibility.
- Flexible layouts encouraged informal learning and group discussion.
- Students expressed greater emotional connection to spaces that allowed personalization and informal ownership, supporting place attachment theory.

c. Proximity and Accessibility to Classrooms

Spatial analysis indicated that informal spaces located within close proximity to classrooms experienced higher engagement levels.

Findings show:

- Informal spaces within short walking distance were used more frequently.
- Visual connection between classrooms and informal areas improved perceived safety and comfort.
- Spaces positioned along primary circulation routes became social nodes.

These findings align with spatial integration theories suggesting that accessibility and visibility drive social interaction.

d. Relationship Between Informal Spaces and Sense of Belonging

Statistical analysis demonstrated a positive association between quality of informal spaces and students'

reported sense of belonging.

Students who frequently used informal learning environments reported:

- Increased social connectedness
- Greater comfort within the school environment
- Enhanced participation in peer activities
- Stronger emotional attachment to school spaces

Conversely, environments lacking informal spatial opportunities showed lower belonging indicators.

6. Design Recommendations

Based on findings and literature, recommended parameters:

- Introduce modular, soft-seating clusters with power outlets.
- Maximize natural daylight and views (addressing Kathmandu's seismic constraints via lightweight partitions).
- Locate informal zones at high-visibility, high-choice intersections.
- Allocate ≥30% of interior area to informal spaces in future designs

7. Conclusion + Design Recommendations

This study investigated how informal learning spaces influence students' sense of belonging in Kathmandu Valley schools. Using mixed methods including spatial analysis, observation, and student surveys, the research demonstrated that architectural design plays a critical role in shaping students' emotional and social experiences.

The findings confirm that:

- Informal learning spaces are essential components of holistic learning environments.
- Students develop stronger belonging through social interaction and spatial autonomy.
- Architectural attributes significantly affect space usage and emotional attachment.
- Proximity and spatial integration enhance engagement.
- Purposefully designed informal spaces lead to more inclusive and socially active school environments.

Ultimately, the research emphasizes that belonging is not only a psychological construct but also a spatial experience shaped by design decisions.

8. Acknowledgements

I would like to express my deepest gratitude to the Department of Architecture, Institute of Engineering, Pulchowk Campus, Tribhuvan University, for providing me with the opportunity and platform to carry out this study. I would like to express our sincere gratitude to course Supervisor Asso. Prof. Dr. Sanjaya Uprety for their guidance throughout the work and all the who participated in the questionnaire survey. I am particularly grateful to Ishwar Man Bajracharya and department of Patan Secondary School and Dr. Lakpa Shrepa who graciously shared their time andschool information.

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