

A Behavior-Responsive Spatial Framework for Adolescent Institutional Care: Translating Environmental Psychology into Orphanage Design

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Abstract

The current environment in children's homes is still unable to fully meet young people's needs for privacy, comfort, a sense of belonging, and healthy social relationships. Such conditions can affect young people's psychosocial development in their daily lives. This study advances a behavior-responsive spatial framework for adolescent institutional care through a qualitative case study at the Darul Aitam Orphanage, Medan, Indonesia. Data were collected through behavioral mapping, structured observation, semi-structured interviews, and questionnaires involving sixteen adolescents aged 12–18, and analyzed using four environmental psychology constructs: personal space, territoriality, crowding, and privacy. Thermal discomfort is a major factor contributing to spatial stress. In bedrooms, a personal space of 60–100 cm is always maintained. Spatial clarity is reduced due to overlapping room functions. Comparative analysis was used to identify spatial designs based on criteria such as interpersonal distance, territorial hierarchy, density reduction, privacy, thermal ventilation, and sensory-stimulating materials. These parameters form a transferable framework for improving spatial quality in orphanage environments. By converting behavioral constructs into measurable spatial thresholds, the study positions behavior-responsive architecture as an evidence-based methodology for adolescent institutional design in comparable tropical institutional contexts.

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INTRODUCTION

Adolescence is a period of self-formation; emotional development and the formation of one's identity are influenced by one's social environment, how one manages their privacy, and their surroundings. (Altman, 1975). In the context of children's homes, these spatial factors are of great importance. In Indonesia, Child Welfare Institutions (LKSA) are largely run by private or faith-based organisations that rely on donations from the public (Kementerian Sosial Republik Indonesia, 2023; Silitonga et al., 2023; UNICEF Indonesia, 2021). Reliance on these institutions has resulted in limited availability of resources and poor quality of facilities, which are key determining factors in the development of children's homes. The challenges faced by children's homes include overcrowding, budgetary constraints, and ageing infrastructure. This results in a lack of personal space, blurred social boundaries, and a weakening of the function of communal areas. These conditions inevitably disrupt privacy and psychosocial well-being amongst adolescents aged 12–18.

In tropical climates, environmental comfort constitutes an additional, often underestimated variable: thermal regulation, natural ventilation, and lighting quality are essential components of habitability that cannot be treated as

secondary design considerations (Adi et al., 2022; Fitriaty et al., 2024; Irsyad et al., 2023; Mba et al., 2023; Nitidara et al., 2025; Padmasari & Hariyadi, 2023). These pressures give rise to design issues that are rarely addressed in institutional guidelines, such as how to design spaces that support adolescent behavior and development (Yusoff, 2021). Environmental psychology and behavioral architecture can serve as a conceptual framework. Affordance theory demonstrates how the environment enables actions, which in turn influence levels of engagement and self-regulation. (Garau & Annunziata, 2020; Gibson, 1979). Flexible and inclusive spatial design encourages a wider variety of activities and fosters a sense of community. (Duman & Uzunoğlu, 2021; Gümüş & Erdönmez, 2021) An intuitive layout, a balanced sensory environment, and green elements enhance emotional comfort and encourage natural use of the space. Appropriate supervision and clearly defined spatial boundaries reinforce a sense of security and clarity regarding territorial boundaries. (Tchinda & Kim, 2020).

Establishing territorial boundaries can reduce conflicts between individuals and strengthen a sense of belonging and connection among residents. (Altman, 1975; Bachtar, 2023; Yang et al., 2020). Although concepts have evolved, many children's homes still employ spatial layouts that are generally plan-oriented, which fail to adapt to the spatial dynamics experienced by adolescents. These shortcomings include undifferentiated multi-purpose spaces, dormitories lacking territorial hierarchy and failing to provide space for social distancing, and an environmental layout that remains very basic. These issues are not only caused by resource constraints but also by the absence of clear spatial guidelines regarding how occupants' behaviors should be accommodated in architectural planning documents. This gap is the primary focus of this research.

Planning a good orphanage means striking a balance between space for communal activities and private space, as well as between supervision and personal freedom. Spread-out small spaces, easily accessible circulation routes, and forms of supervision that do not intrude can make this balance a reality without sacrificing individual rights (Duman & Uzunoğlu, 2021; Gümüş & Erdönmez, 2021). A multi-tiered spatial hierarchy and layered privacy elements determine the extent to which residents can be approached by others. (Garau & Annunziata, 2020; Tchinda & Kim, 2020) A calm environment with diverse sensory stimuli has been shown to influence positive mood and behavior in adolescents. (Kaplan & Kaplan, 1989; Liang et al., 2025). This study employs behavioral mapping, structured observation, and a participant-centered approach. Behavioral evidence was interpreted into measurable spatial parameters (Bocheńska-Skałicka & Walter, 2020; Garau & Annunziata, 2020), within a general design framework for the objective assessment of a group of adolescents' behavior (Duman & Uzunoğlu, 2021; Jansson et al., 2022). The resulting strategies include personal space, territorial hierarchies, and layered surveillance mechanisms as management controls over residents' privacy (Garau & Annunziata, 2020; Jansson et al., 2022). The entire design process was developed collaboratively, directly involving the residents, thereby strengthening their sense of autonomy and ownership of the space (Makkonen et al., 2023). This study produced a spatial framework responsive to behavior and context, formulated into seven design parameters: measured private space, layered territories, improved ventilation, flexible partitions, and ergonomic furniture aligned with the needs of adolescents (Duman & Uzunoğlu, 2021; Garau & Annunziata, 2020; Liang et al., 2025).

The objectives of this study are to critically examine how the design of orphanage spaces has neglected the behavioral needs of adolescents by situating this gap within Altman's (1975) conceptual framework regarding personal space, territoriality, density, and privacy, as well as Gibson's (1979) affordance framework, as adopted by Garau & Annunziata (2020). The second objective is to develop a design approach in which behavioral mapping and participant observation are used as direct inputs for spatial specifications (Bocheńska-Skałicka & Walter, 2020). The third objective is to consolidate empirical findings into room-specific guidelines, organized into seven design parameters covering personal space, territorial hierarchy, thermal comfort, and privacy gradients (Altman, 1975; Irsyad et al., 2023; Liang et al., 2025). Overall, these objectives reflect a shift in the approach to orphanage architecture, moving away from starting with floor plans and instead beginning with the spatial behaviors of the people living within them. The resulting framework is based on observed thresholds rather than normative assumptions and is designed to apply to similar designs. The research was conducted in several stages, ranging from mapping to triangulation and specification, and was clearly documented so that others could adapt it to their specific contexts. This research demonstrates that the design of an orphanage requires careful consideration, rather than simply fitting the furniture to the available floor space. Spatial decisions in care homes either support or undermine adolescent behavior in terms of how they provide privacy, territory, and social life. It is these design issues that will be discussed in this research.

METHODS

Research Design

Behavioral architecture and environmental psychology form the foundation of this qualitative study (Duman & Uzunoğlu, 2021; Garau & Annunziata, 2020). To understand the behavior of adolescents in orphanages, this study

was designed sequentially and subsequently translated into design criteria. Assessment indicators such as personal space, number of residents, and questionnaire scores were recorded to clarify interview results and data analysis, but not for statistical purposes (Creswell & Plano Clark, 2017). The research stages consist of (1) case selection, (2) behavioral mapping and structured observation, (3) interviews and questionnaires, and (4) analysis and framework development. Adolescents living in orphanages are the subjects of this study regarding spatial boundaries and the impact of their behavior. Altman (1975) states that the model of privacy-establishing interactions is not a perspective based solely on environmental factors.

Study Site and Participants

The research was conducted at the Darul Aitam Orphanage in Medan, Indonesia. The study focused on the prayer room, dining room, and bedrooms. The participants were adolescents aged 12–18 years living at the orphanage; sixteen adolescents were involved in this study. The sixteen adolescents were grouped based on gender, age, and length of stay, as shown in Table 1. The study could only be conducted after obtaining permission from the orphanage management. Before conducting the research, the research team requested permission from the orphanage management. Prior to the observations and interviews, the sixteen adolescents were provided with an explanation and briefing regarding the study to be conducted and were informed that they could withdraw if they did not wish to participate. Since the participants were under 18 years of age, written consent was provided by the orphanage management. To maintain confidentiality, each participant was assigned a code from P1 to P16, and interview sessions were conducted only if the participant agreed.

Table 1. Participant Data

Characteristic	Category	n	%
Gender	Male	6	37.50
	Female	10	62.50
Age Group	12–14 years	5	31.25
	15–18 years	11	68.75
Duration of Residence	< 2 years	3	18.75
	2–5 years	8	50.00
	> 5 years	5	31.25

Data Collection

Literature Review

The theoretical foundation for behavioral observation, particularly in the fields of environmental psychology (Altman, 1975; Holahan, 1982), behavioral architecture (Garau & Annunziata, 2020; Liang et al., 2025) and research on the design of residential facilities for adolescents (Jansson et al., 2022). The framework was derived from a literature review to synthesize theories of affordance, proxemic construction, sensory environments, and design principles.

Behavioral Mapping and Structured Observation

Behavioral mapping was conducted in three spaces, the prayer room, the dining room, and the bedroom, following guidelines focused on both the environment and the individual (Bocheńska-Skałicka & Walter, 2020; Zeisel, 1981). Observations were conducted over three days, during two time periods each day: in the morning between 7:00 AM and 9:00 AM, and in the evening between 6:00 PM and 9:00 PM. These times were selected to document differences in how adolescents occupy and share space across various activities. Since no measuring tools were brought into the space, distances were estimated using the physical dimensions of surrounding objects, such as the width of chairs and the length of beds, as informal spatial references. It is known that the distance between individuals falls within the range of 60 to 100 cm. This aligns with what Hall (1969) defined as personal space. Photographs and field sketches support the coding and cross-verification of spatial patterns (Garau & Annunziata, 2020).

Interviews and questionnaires

Behavioral mapping was conducted at predetermined times, followed by structured interviews with sixteen respondents. The interview questions consisted of (a) perceptions of comfort and discomfort in each space under

study; (b) privacy priorities and stressors related to environmental conditions; (c) territoriality and strategies for managing personal space; and (d) suggestions for improving the space. Interviews were recorded with participants' consent. A structured questionnaire using a three-point response scale (Positive/Moderate/Negative) was administered to measure overall spatial satisfaction based on five indicators: overall opinion, comfort level, suitability of size, suitability of facilities, and preferences. These five indicators were used to develop a spatial satisfaction framework applied in orphanage settings (Sanni-Anibire & Adenle, 2024; Yang et al., 2020) and modified into a simpler scale that is easier for all respondents to understand. This simplified scale is designed to supplement interview data by identifying consistent patterns among participants.

Data Analysis

The data collected were classified based on the environmental-behavioral theory of Altman (1975) and Holahan (1982):

- a. **Personal space**, analyzing the results of proxemic distance observations, based on Hall (1969): intimate distance is approximately 45 cm, personal distance is between 60–100 cm, and social distance is between 100-200 cm. Any violations of personal space will be correlated with the discomfort reported by the participants.
- b. **Territoriality** is mapped into three levels: primary territory (e.g., the bed, personal storage), secondary territory (e.g., study areas or shared seating), and public territory (e.g., corridors, prayer lines). The analysis is based on classifications by Altman's (1975) and Bachtiar (2023), where intimate, personal, and social zones are mapped through behavioral patterns based on activities, individual behaviors, and typical patterns of space occupation, coded as territorial indicators.
- c. **Crowding and density** are reinterpreted based on observed occupancy levels and the comfort levels reported by participants. Behavioral responses to density, including movement, withdrawal, and adolescents' reactions to negative stimuli, were identified and linked to spatial configurations.
- d. **Privacy** was analyzed through visual, auditory, and communicative dimensions. All observational findings were recorded alongside interview results regarding satisfaction with privacy and perceived comfort boundaries.

All data were integrated through qualitative triangulation (Creswell & Plano Clark, 2017). Alignment between behavioral mapping, documentation, and interview results is necessary to strengthen interpretive validity. Interview topics were systematically mapped based on Altman (1975) theory, among other things (a) personal space through descriptions of discomfort when others enter areas considered private; (b) territoriality through descriptions and behaviors that mark the boundaries of one's territory; (c) density through reports related to withdrawal, irritability, and movement; and (d) privacy through visual separation and the desire to control boundaries. For example, the behavior of a group of teenagers in a prayer room was identified through mapping centered on a single location. This is supported by interview results regarding stress caused by heat, reinforcing the primacy of thermal discomfort.

RESULTS AND DISCUSSION

Prayer Room (Musholla)

In addition to being used for worship, this space also serves as a gathering and relaxation area for the orphanage residents. During the mapping process, three recurring patterns emerged, as shown in **Figure 1**. Most residents gather under the ceiling fan along the right side of the prayer room. Several small groups form spontaneously in the prayer rows, engaged in conversation. One or two people occasionally move to the edge of the room, engrossed in their cell phones. Although it is crowded, the prayer area is always empty. This indicates that there is an agreed-upon boundary between the sacred area and the space used for daily activities. These observations reveal that thermal factors and spatial boundaries subconsciously shape occupants' sense of attachment to a place, leading them to choose locations not based on formal rules, but rather on a desire for comfort (Garau & Annunziata, 2020; Mba et al., 2023).

Residents generally view the prayer room positively. This is shown in **Table 2**. More than 80% of respondents gave positive ratings on all indicators, and all respondents stated that the prayer room is adequate. About 93.8% of respondents gave positive ratings regarding their level of satisfaction with the facilities and the comfort of their use. However, these figures do not fully reflect the actual conditions. In terms of thermal comfort, only 18.7% of residents felt comfortable, which is lower than the results of the interviews. Heat and noise were the most frequently mentioned complaints. The prayer room was described as sufficiently spacious, but it felt uncomfortable when crowded. As stated by P7, partition curtains are needed because P7 felt uncomfortable praying right next to young boys. Meanwhile, P12 explained that the heat affected their seating positions; they would move closer to the fan when the room became crowded and hot. These conditions align with the behavioral mapping results, as occupants tend to

gather near the fans in response to thermal conditions. Additionally, the absence of partition curtains leaves occupants without a means to adjust the boundaries of the space to suit their needs (Altman, 1975; Hall, 1969). This prayer room is open and unpartitioned, designed for communal worship, yet it does not provide visual privacy for its occupants when they need it. Residents have suggested the addition of retractable curtains, improved cross-ventilation, and better lighting. The residents' wish is to have greater control over their spatial experience while maintaining the dual function of the prayer room as both a ritual space and a social space (Garau & Annunziata, 2020).

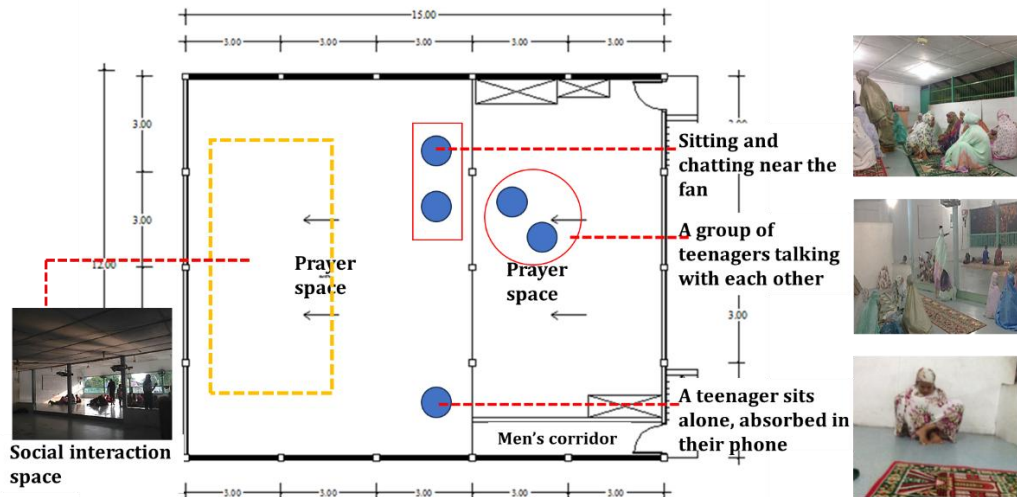


Fig. 1. A behavioral mapping of the prayer room (Musholla)

Table 2. Teenagers' Perceptions of Mosholla

Indicator	n	Positive (%)	n	Moderate (%)	Negative (%)
Overall opinion	15	93.8	1	6.2	0
Comfort level	13	81.3	3	18.7	0
Size suitability	16	100	0	0	0
Facility suitability	15	93.8	1	6.2	0
Overall preference	15	93.8	1	6.2	0

Note: **Positive** = Very Good/Good/Very Comfortable /Comfortable **Moderate** = Fair/Fairly Comfortable **Negative** = Poor/Uncomfortable

Because the sample size is small (n = 16), absolute frequencies (n) are reported alongside percentages to avoid misunderstanding.



Fig. 2. Interior design recommendations for a musholla

Dining Room

A warm, friendly atmosphere always prevails in the dining room during mealtimes. All the residents sit together, facing each other at long tables, chatting and eating together. Based on observations and mapping, the sense of togetherness is not an issue; however, recurring problems occur at the edges of the space, such as clothes hung out to dry and parked motorcycles (**Figure 3**). The use of space for activities other than eating narrows the usable area and creates spatial confusion, such as where exactly the dining area is and what is reasonably expected of that space.

This kind of overlapping use of space not only creates chaos, but it also reduces order and the residents’ sense of territorial ownership within the shared dining environment (Gümüş & Erdönmez, 2021; Ismail et al., 2017).

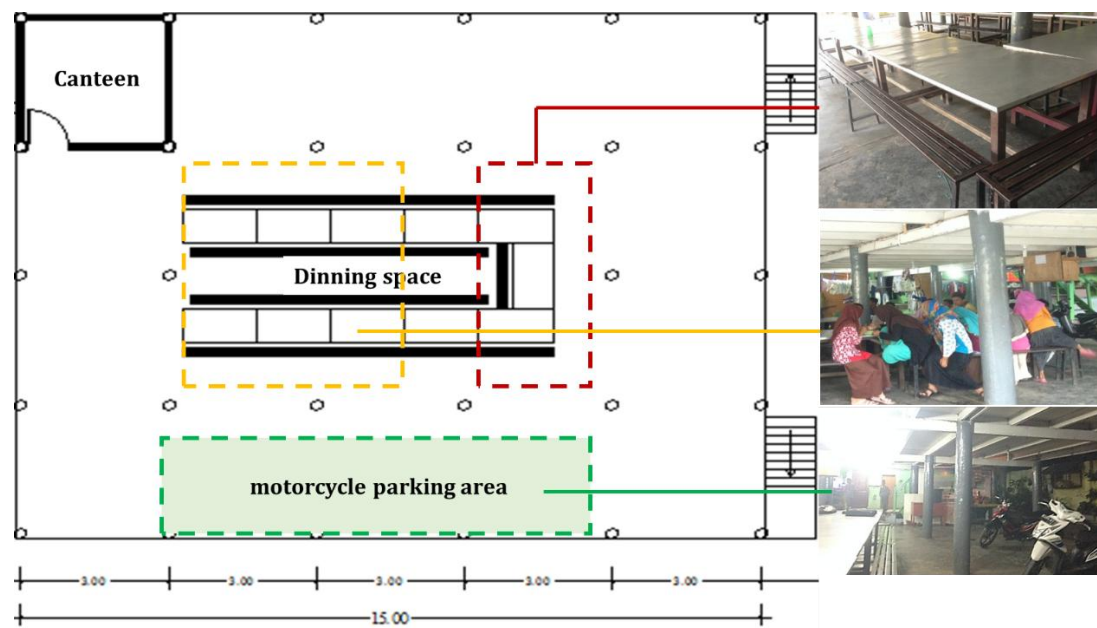


Fig. 3. Floor plan of the dining room, showing overlapping functions

Table 3 shows that residents generally have a positive perception of the dining area, both in terms of comfort and social interaction. However, the indicators for comfort and social interaction recorded the lowest positive scores, at 68.8%, with more than 30% of respondents giving only a “moderate” rating. This suggests tension and discomfort that certainly cannot be explained by numbers alone; direct observation is necessary. From the questionnaire results, one resident gave a negative assessment of the conditions of the orphanage facilities, with a score of 6.3%. Although this is a small percentage, it warrants attention. Interview results can supplement the data obtained from the questionnaire. As described by P3, mealtime is like a family gathering. P9 noted that while the dining room is crowded during mealtimes, the open layout of the surrounding space reduces the feeling of crampedness. P3 and P9 demonstrated a strong attachment to the space. P5 felt uncomfortable with clothes hanging to dry and motorcycles parked near the dining room. This situation indicates overlapping room functions, making the actual purpose of the space unclear. What these teenagers shared reveals their social lives while in the dining room, such as their habits and their relationships with one another. The teenagers adapt to the existing spatial arrangement.

Table 3. Results of the Questionnaire in the Dining Room

Indicator	n	Positive (%)	n	Moderate (%)	n	Negative (%)
Overall opinion	14	87.5	2	12.5	0	0.0
Comfort	11	68.8	5	31.2	0	0.0
Social interaction	11	68.8	5	31.2	0	0.0
Size suitability	12	75.0	4	25.0	0	0.0
Facility suitability	13	81.3	2	12.5	1	6.3
Preference	15	93.8	0	0.0	1	6.3

Note: **Positive** = Very Good/Good/Very Comfortable/Comfortable; **Moderate** = Fair /Fairly Comfortable; **Negative** = Poor/Uncomfortable.
Because the sample size is small (n = 16), absolute frequencies (n) are reported alongside percentages to avoid misunderstanding.

Figure 4 shows the dining room, which was redesigned according to the residents’ wishes: a comfortable space that feels like their own. The dining room is enclosed by a one-meter-high railing, with the floor raised slightly by about ten centimeters. Both elements serve to define the dining area while still maintaining a sense of spaciousness. The ceiling was raised to reduce the feeling of heat in the room. The drying area and motorcycle parking were moved to the back of the dining room. The dining chairs were accented with blue and yellow to serve as visual cues, so residents can easily identify their seats. Wooden furniture and parquet flooring were chosen to create a warm atmosphere (Sanni-Anibire & Adenle, 2024).



Fig. 4. Recommended design of the dining area with a partition and raised flooring

Bedrooms (Personal Spaces)

The occupants of the four bedrooms consistently maintained their personal space approximately 60 to 100 cm while engaging in activities in the bedroom, even in crowded bedrooms where personal space remained the same (Figure 5). There was no agreement regarding this personal space, but rather it stemmed from their daily habits while in the bedroom. This aligns with Hall's (1969) perspective, which explains proxemic norms as habits rather than the result of negotiation. Territorial mapping manifested in layers. The bed and storage cabinets are areas avoided by other residents because they are considered private spaces, even though the bedroom is shared. The corner of the room is used for studying together, while the corridor area is used by all residents to socialize with one another. A three-layered territorial pattern is present in all four bedrooms, although residents' activities within them vary depending on the room size, the number of residents, and how long each person occupies the space (Altman, 1975).

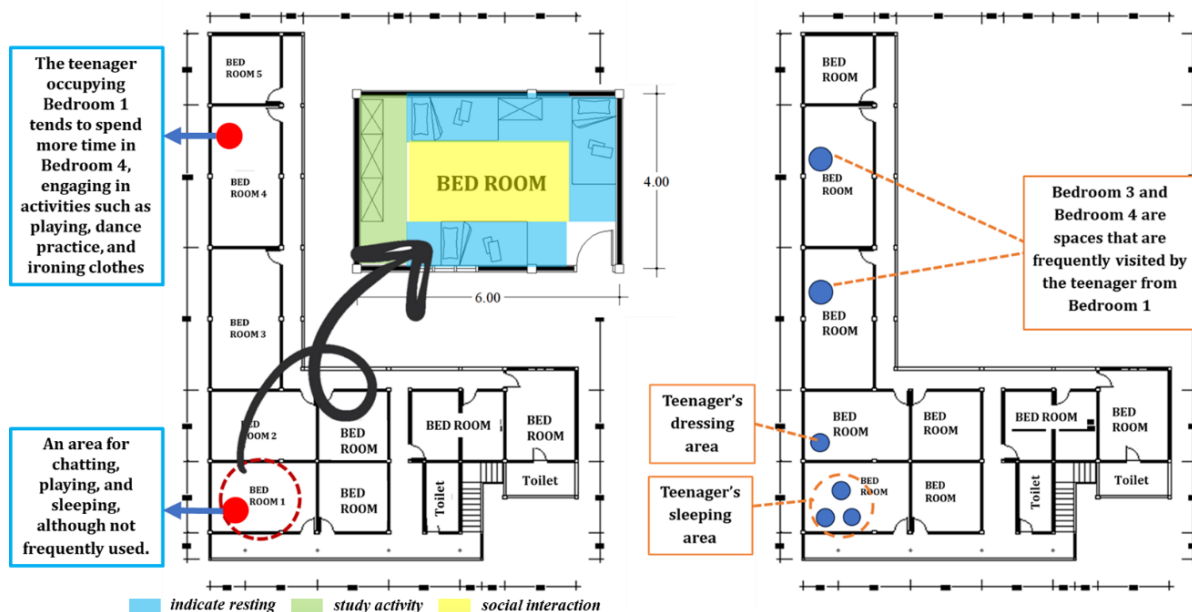


Figure 5. An illustration of interactions between bedrooms showing the movement patterns of teenagers across four bedrooms

The temperature differences among the four bedrooms are quite noticeable. Bedroom 1 is the smallest of the four and gets quite hot in the afternoon. P2, who stays in Bedroom 1, moves to one of the cooler rooms every day to study or rest. All residents know which room is more comfortable for gathering after school. This movement of residents to other rooms, of course, has a negative impact on the occupants of those rooms, such as a loss of a sense of ownership over the bedroom. Bedroom 2 measures 2×2.5 m, differing from Bedroom 1. Though not very large, it is sufficient for the residents without disturbing one another. Bedrooms 3 and 4 have different problems: territorial boundaries are less clear, and tensions regarding the use of shared tables and shelves occur more frequently there than elsewhere. The lesson from these four rooms is that equal floor space alone does not result in territorial clarity. Territorial clarity is derived from the articulation of physical boundaries.

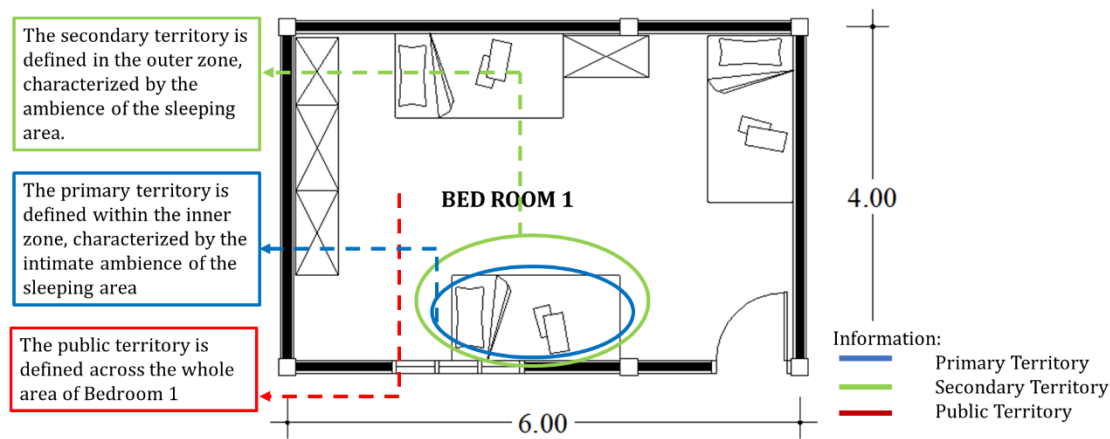


Fig. 6. The territorial hierarchy in Bedroom 1

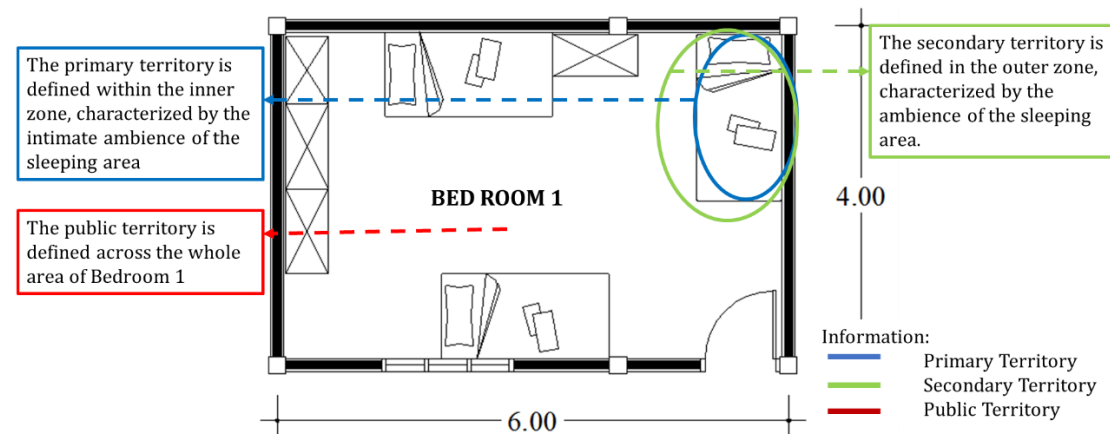


Fig. 7. The territorial hierarchy in Bedroom 2

The territorial classifications shown in **Figures 6 and 7** were derived from three mutually supportive sources: physical markers such as beds and storage areas; observed patterns of space use, such as the habit of returning to specific zones; and a sense of ownership expressed by participants during interviews, in accordance with Altman's (1975) operational definition of territorial behavior. Significantly, thermal comfort varies between rooms. Bedroom 1's heat problem was not just a matter of physical discomfort. When a room becomes too hot to use in the afternoon, its occupants stop occupying it; they migrate, as P2 and P11 both described, to wherever the air feels tolerable. Holahan (1982) would recognize this immediately: when people cannot regulate their environment, they regulate themselves by leaving it. What the bedroom data reinforces, alongside evidence from tropical building studies, is that no single fix resolves this not one extra fan, not repainting the walls. Thermal habitability in this climate requires decisions made together across ventilation, shading, and material choice (Irsyad et al., 2023; Mba et al., 2023; Padmasari & Hariyadi, 2023). Bedroom 2 is in better condition with its more adequate space, coupled with improved visual appeal and increased personal space for its occupants (Sanni-Anibire & Adenle, 2024). Bedrooms 3 and 4, despite their larger size, actually lead to social withdrawal. This occurs due to high occupancy density and inadequate lighting. To accommodate evolving social needs, it is recommended to improve the lighting system and furniture layout (Jansson et al., 2022; Ramadani et al., 2025).

Figure 8 shows a design recommendation for a bedroom in an orphanage. This design was created to address issues in the bedroom, namely the hot temperature and unclear spatial boundaries. The space is arranged with a personal distance of 60-100 cm in mind. Storage cabinets serve as visual dividers between residents but are not fully enclosed. Lighting within the dormitory room is also arranged to ensure residents feel comfortable, with distinct lighting for studying and for sleeping. This spatial layout and lighting arrangement are based on what the residents have communicated regarding their comfort and privacy in the dormitory rooms, so it is not a typical orphanage design (Altman, 1975; Holahan, 1982). From the observations and data collected, the same issues were found in all three spaces the prayer room, dining hall, and bedrooms, namely unclear territorial boundaries and overheated conditions. Residents did not directly express their spatial discomfort, but it was evident in their behavior, such as moving to cooler spots, shifting to avoid crowds to create their own privacy, and maintaining personal distance. This constitutes a response to the existing spatial conditions. Tropical building principles can be applied to this orphanage, such as the use of cross-ventilation, shading, appropriate material selection, and spatial layout (Adi et al., 2022;

Fitriaty *et al.*, 2024; Irsyad *et al.*, 2023; Mba *et al.*, 2023; Padmasari & Hariyadi, 2023; Yusoff, 2021), supported by a multisensory design (Nitidara *et al.*, 2025) to create comfort, particularly in shared spaces such as the prayer room and dining room.



Fig. 8. Recommended interior design for Bedrooms 1 to 4

Cross-Space Comparative Analysis

Table 4. Cross-Space Behavioral Comparison Across Three Spatial Models

Construct	Prayer Room (Musholla)	Dining Room	Bedrooms
Personal Space	Gathering near a fan reduces personal space; using a phone at the edge of the corridor demonstrates behavior that maintains personal space	A linear seating arrangement promotes a reasonable distance between people; during busy mealtimes, it reduces empty spaces.	Personal space is between 60 and 100 cm; intimate space is approximately 45 cm, as can be seen from the side of the bed.
Territoriality	The territorial hierarchy between the sacred zone and the informal periphery marks the physical boundaries.	The boundaries are unclear; functions overlap with other activities; there is a weak sense of ownership (territorial).	Primary territory (sleeping area); secondary territory (play area); the corridor serves as a communal area.
Crowding	The density is located beneath the fan; this density reduces thermal comfort.	Functional density resulting from shared use; whilst there are sufficient seats, the poor layout gives the impression of being cramped.	Overcrowded small rooms are causing teenagers to move to other areas; spacious rooms are not being used to their full potential.
Privacy	A clear separation by gender is required; visual exposure during prayer is considered inappropriate.	Lack of privacy; eating together is the norm.	The greatest need for privacy of all spaces; the key strategy for addressing this is to create personal spaces.
Primary Stressor	Thermal (heat) with acoustic (noise)	A multi-purpose room with an irregular layout.	Thermal (heat) with an emphasis on territorial aspects.
Primary Affordance	Social bonds are strengthened through rituals.	Community bonds; shared identity	Autonomy, identity formation, and collaborative learning.

Behavioral patterns in places of worship, dining rooms, and bedrooms exhibit different dynamics, but some principles apply equally across all rooms. The results of this comparison are shown in **Table 4**. From the comparison, three commonalities were identified: (a) the most common stressor in all three spaces is thermal discomfort. This

indicates that thermal analysis related to ventilation must form the basis of a design tailored to specific needs. (b) Territorial ambiguity leads to withdrawal or conflict among occupants. This finding suggests that territorial hierarchy is a key determinant of spatial stability and occupant well-being (Bachtiar, 2023). (c) The level of privacy in the dining room is considered low; the bedroom requires a high level of visual and territorial privacy, while the prayer room falls somewhere in between. These differences in privacy levels directly influence design concepts, such as spatial division, the selection of visual barriers, and territorial distinctions throughout the space.

Behavior-Responsive Spatial Framework

Table 5. Behavior-Responsive Spatial Framework for Adolescent Orphanage Design

No	Parameter	Behavioral Construct	Observed Evidence	Spatial Threshold	Design Response
1	Interpersonal Spacing	Personal space (Hall, 1969)	60-100 cm buffers maintained across bedrooms; proxemic compression beneath fans in musholla	Minimum 60 cm clear distance between beds/seating positions; intimate zone (45 cm) acknowledged in layout	Reposition furniture; define minimum clear distances as non-negotiable layout brief criteria
2	Territorial Hierarchy	Territoriality (Altman, 1975)	Bed and storage = primary; study corners = secondary; corridors = public territory across all typologies	Distinct physical or visual markers differentiate each territorial level	Vertical partitions, individualized storage, zone differentiation by material finish or color
3	Crowding Mitigation	Crowding/density (Holahan, 1982)	Displacement from dense bedrooms; functional overcrowding in dining from multi-use co-location	Maximum 4 occupants per 12 m ² in sleeping areas; single-function zoning in communal spaces	Reduce bed density; separate incompatible functions; provide designated overflow or transition space
4	Privacy Gradient	Privacy regulation (Altman, 1975)	Explicit gender partition requests in musholla; curtain use and personalization in bedrooms	Layered screening: soft (retractable curtain): semi-rigid (low operable partition): solid (full wall)	Retractable curtains; low operable screens; gender-sensitive visual barriers in shared spaces
5	Thermal-Ventilation	Environmental comfort (Holahan, 1982; Irsyad et al., 2023; Mba et al., 2023; Padmasari & Hariyadi, 2023)	Fan-clustering behavior in musholla; thermal displacement across bedroom typologies	Cross-ventilation openings $\geq 10\%$ of floor area; ceiling fans at maximum 3 m spacing	Natural cross-ventilation design as primary strategy, with openings $\geq 10\%$ of floor area and side-lit configuration to minimize solar heat penetration (Cung & Rosetia, 2023; Yusoff, 2021); supplementary mechanical cooling where needed; opaque ceiling as thermal barrier to prevent attic heat transfer (Fitriaty et al., 2024)
6	Acoustic Buffering	Crowding/privacy overlap (Altman, 1975)	Noise cited as secondary stressor in musholla and dining room; acoustic density compounds thermal discomfort	Soft furnishings for absorption; high-noise activity zones separated by a minimum of 3 m or interposed buffer	Textile wall panels; spatial zoning of high-noise activities away from study and sleeping zones
7	Sensory-Material Comfort	Affordance (Garau & Annunziata, 2020)	Consistent preference for clean, warm, and well-lit environments expressed across all typologies	Warm neutral color palette; ambient and task lighting differentiation; natural material surfaces	Wood/parquet floor finishes; layered LED lighting (ambient and task) with minimum 350 lux task illumination (Ramadani et al., 2025); green accent elements for psychological restoration (Kaplan & Kaplan, 1989; Liang et al., 2025).

A synthesis of behavioral evidence from the three spatial models (prayer room, dining room, bedroom) yielded seven design implementation parameters that form the proposed Behavior-Responsive Space Framework presented in **Table 5**. Each parameter is based on specific behavioral patterns identified in the data, supported by behavioral observations, and translated into measurable spatial transitions and design responses. This framework is designed to be contextually adaptable in orphanage settings with tropical climates comparable to similar implementations. The framework's transferability is contingent on three contextual conditions: (a) a warm-humid tropical climate requiring active thermal and ventilation strategies; (b) institutional occupancy by adolescents aged 12-18 exhibiting the proxemic and territorial behavioral norms documented in this study; and (c) facilities incorporating at least three spatial typologies: sleeping, communal eating, and shared ritual or activity spaces. The framework parameters can be directly applied to architectural design guidelines and spatial planning documents. In the context of different climatic or cultural conditions, Parameters 4 (Privacy Gradient) and 5 (Thermal-Ventilation) require adaptation to local conditions. In cold climates, ventilation strategies shift from cross-ventilation to thermal insulation and heat retention. In cultural contexts with different norms regarding gender segregation or communal living, privacy gradient specifications are discussed between residents and orphanage management.

CONCLUSION

Darul Aitam is one of the orphanages in the city of Medan, Indonesia; however, behavioral analysis has revealed that its design is not responsive to local conditions. The adolescents at the orphanage establish closeness, personal space, and thermal comfort in the same way regardless of their location. This study offers a structured approach to translating these tendencies into practical spatial specifications. The presented framework with seven parameters encompasses personal space, territorial hierarchy, density-reduction measures, privacy gradients, thermal-ventilation testing, noise barriers, and sensory-material problem-solving (**Table 5**). User-behavior-responsive design serves as the working methodology in this study. Three key underlying findings: heat is the most significant perceived disturbance across all types of spaces and cannot be ignored in the design process; unclear spatial boundaries consistently prompt occupants to avoid or conflict with one another; and privacy needs depend on the degree of personal space, so the selection of partition types must be tailored to the function of each specific space, not applied uniformly.

This framework still has limitations: the study was conducted on only one case involving 16 respondents; there is no data on what happened after the residents moved in; and the assessment scale used was fairly simple. Therefore, the results cannot be directly applied to any design, but only to similar climatic and environmental conditions. Moving forward, research needs to be expanded to include more locations, and involve adolescents as active participants in the design process. The proposed spatial specifications remain pending validation through post-occupancy evaluation (POE) (cf. Mba et al., 2023), which should examine how residents' behavior changes after the physical modifications are implemented.

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