

# ADAPTATIONS OF LIVING SPACES FOR CHILDREN'S ACTIVITY IN APARTMENTS: ERGONOMICS INTERVENTIONS FOR AUTONOMY AND SAFETY

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**KEYWORDS:** *Adaptation, Child, Ergonomics of the Built Environment, Housing*

## ABSTRACT

Childhood constitutes a fundamental stage in the construction of subjectivities and spatial relationships, and must therefore be recognized as a legitimate social category in urban and architectural planning. This article analyzes how children appropriate the space in their homes, with emphasis on the ergonomic dimensions of apartments. The research adopts a qualitative, interpretative approach, grounded in Ergonomics of the Built Environment, to analyze a case study of a family living in Maceió, Alagoas, Brazil. The analyses reveal imbalances in children's use of indoor domestic environments, as there is often no planning for their safe, autonomous use. In response, the article proposes ergonomic recommendations that enhance the home adaptability and encourage children's autonomy without requiring major structural modifications. The study contributes to advancing reflections on more inclusive forms of dwelling for childhood, with potential for replication across different family contexts.

## INTRODUCTION

Housing, as a spatial and cultural category, is a fundamental milestone in architecture, from its most rudimentary forms to its evolution beyond mere physical shelter, becoming a space for intimacy, coexistence, and the building of bonds. The house, understood as a place of habitation in its most diverse forms and dimensions (Dicio, 2024), acquires meaning from the familiarity built up in everyday life, as Massola & Svartman (2018) observed. However, this private character is relatively recent; historically, housing has integrated shared uses and practices in the public domain, as highlighted by Pires (2018). Residential space is similar to a micro-reproduction of urban, cultural, and climatic dynamics. As a collective work, the home "far exceeds the function of shelter" (Leitão, 2009, p.47), reflecting social transformations and ways of life. In recent decades, the reduction of usable areas, especially in apartments, has intensified the need for more flexible design, leading families and professionals to reorganize environments to accommodate children's activities in spaces that are often insufficient for play, study, and interaction. In this regard, studies of the Ergonomics of the Built Environment make fundamental contributions by considering stimulation, safety, and health in the practical and daily use of environments (Attaianese, 2011; Ferrer et al., 2022). Effectiveness in residential

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building refers to how well architectural design supports daily activities without compromising user wellbeing. The ability to identify and address risks that could impact the health and safety of occupants—potentially altering or limiting how the building is used—becomes a key criterion for evaluating a building's functional effectiveness. Such assessments can be carried out by developing protocols to identify and analyze health-related risks (Attaianesi & d'Angelo, 2018). Oliveira (2021) argues that child development is inseparable from the child's active relationship with the physical and social environments. This perspective converges with Thibaud (2018) in recognizing the subject as an explorer of space and emphasizing the role of environmental experiences in cognitive, psychosocial, psychomotor, and linguistic development. Despite this relevance, few studies examine the interaction between children and the home environment from an ergonomic perspective that centers the child in the design process. The prevailing literature focuses on anthropometric parameters of adults, neglecting stages of the life cycle such as childhood and old age (Boueri Filho, 2008; Panero, 2016; Iida, 2016). Even in Brazil, where children and youth are a significant population, literature and technical standards, such as NBR 15575-1 (ABNT, 2013), offer generic recommendations focused primarily on the performance of buildings and furniture, without considering the specific needs of children. Given this gap, this article aims to understand how Brazilian children use the indoor environments of an apartment, considering their daily demands for safety, autonomy, and development. The investigation examines the daily life of a middle-class family of four. The study derives from a master's research conducted in the Graduate Program in Architecture and Urbanism at the Federal University of Alagoas, further explored here from the perspective of Ergonomics of the Built Environment.

## THEORETICAL FOUNDATION

The theoretical foundations consider three interdependent axes: (i) the child, covering their developmental milestones and relationship with the built environment; (ii) the living space and its role as a mediator and stimulator of child development; and (iii) the ergonomics of the built environment, highlighting the child-activity-environment triad as a design basis for promoting autonomy, safety, and wellbeing. The starting point for this discussion is the idea of home, whose understanding, in the Brazilian context, is linked to family dynamics and social hierarchies. According to Tuan (1930, p. 14), housing constitutes "a concretion of value [...] an object in which one can live," thereby extrapolating its material role and assuming symbolic and affective dimensions. Historically, dwellings have adapted to sociocultural and economic transformations (Villa, 2020), so that their various users and producers become responsible for the continuous reformulation of space and its ambience. Thus, housing expresses complex, changeable processes of appropriation associated with its occupants' living conditions. People spend approximately 15.7h of their day (65%) indoors, including sleep hours; optimizing residential quality and assurance may promote greater comfort, health, and overall wellbeing (Foldvary, 2016). Additionally, children, older adults, and individuals with health issues are particularly susceptible to the adverse effects of poor indoor quality environments (Wu et al., 2017). Environmental Psychology contributes to understanding concepts such as ambience and user-space relationship (Thibaud, 2018; Pinheiro, 2018), considering the home and children's relationship. Each environment has a unique ambience, consisting of social, individual, physical, and affective dimensions that shape behaviors and perceptions. This comprehension is

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essential for analyzing children's experience of indoor home space, as their daily experiences are defined and controlled by responsible adults, caregivers, or architects (Bezerra et al., 2024). It is in early childhood that they build spatial repertoires, assign meanings to places, and develop perceptions through their movements and interactions with the environment (Erthal, 2023). In this sense, this research places children at the center of scientific debate, understanding childhood as a strategic stage for socio-spatial development. This perspective converges with Ferraro and Azevedo (2023), who recognize that childhoods are everywhere, marked by generational singularities and contextual differences. Such complexity reinforces the need to understand how children construct meanings about the world from the spaces they inhabit, internalizing social hierarchies, behavioral norms, territorialities, and cultural references (Migliani, Almeida & Imbrunito, 2021). The built environment, therefore, acts as an agent of stimulation and mediation, favoring learning, sensory experiences, and emotional bonds that support the child's integral development (Silva & Barbosa, 2024). Just as spaces for adults meet their functional and psychological demands, spaces for children should follow similar premises. Oliveira (2021) points out that the way the home welcomes children and influences their daily experience is an essential part of an ergonomic design answer. Considering anthropometric aspects, physical limitations, and autonomy needs is therefore indispensable for promoting child safety and development. Creating spaces that are sensitive to children's needs entails understanding how children perceive, explore, and redefine housing, and articulating its functional, emotional, and symbolic dimensions (Oliveira, 2021). Investing in more inclusive and responsive environments constitutes a disciplinary and social advance, capable of promoting healthier, more creative, and emotionally rooted developmental trajectories.

## **METHOD**

The research adopted a qualitative, interpretative approach to understand the phenomenon in its social context, as outlined by Sampieri et al. (2013). The aim is to identify how the domestic environment affects children's developmental stages and how direct observation of use experiences contributes to the formulation of ergonomic strategies that make housing safer and more responsive to children's needs. This approach enabled the analysis of meanings, practices, and interactions, contributing to the field of Ergonomics of the Built Environment, focused on creating more humane and egalitarian living spaces. The field collection occurred in two complementary stages: the first is physical, involving detailed characterization of the environment through architectural surveys, photographic records, flow maps, and the identification of daily activities via "icebreakers" moments and walkthroughs. The second stage is cognitive, comprising the systematic observation of environments in use and the identification of "islands of autonomy and learning" based on users' perceptions and spatial appropriation. The data analysis integrated the physical, dimensional, and perceptual aspects of the apartment in use, using a scientific-descriptive and interpretive approach. The project was submitted to and approved by the UFAL Research Ethics Committee under Certificate of Presentation for Ethical Review (CAAE) No. 77289824.7.0000.5013, and each participant received and signed the Free and Informed Consent Form (FICF) after receiving clarification on the objectives and procedures of the investigation.

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## Characterization of the research site

As this is a case study (Sampieri et al., 2013), the characterization of the research site focused on the Arlindo Soares Residential Building in the Jatiúca, a neighborhood of Maceió, Alagoas. It is a middle-class multi-unit building, situated in a consolidated urban area near supermarkets, hospitals, and schools; these services provide the family's daily infrastructure and influence children's routines and movements. The apartment unit chosen for the case study is on the sixth floor of the building. It has a living and dining room integrated with a balcony. The service is composed of a kitchen, a laundry, a deposit, and a service bathroom, totaling 95.10 m<sup>2</sup> (Figure 1). The unit has four bedrooms: the first is the parents' room, the second and third are each child's room, and the last is an office for the whole family.



Figure 1. Apartment 03 - Arlindo Soares Building

Considering Maceió's tropical-humid climate, the building is west-facing, which receives year-round sunlight, contributing to perceptions of inadequate ventilation and high indoor temperatures, as well as to solar incidence on the balcony and bedrooms. The building is located on a corner and has no shading barriers, making this apartment unit the warmest on the same floor.

## Characterization of participants

Characterization of participants is fundamental to the proposed ergonomic analysis. The family consists of four members: the parents, father and mother, a 9-year-old son, and a 6-year-old daughter. The family values the quality of the environment and prioritizes organization, cleanliness, and comfort in daily-use spaces. For ergonomic assessment purposes, the anthropometric parameters of the children are described, such as height, upper reach, and lateral reach, as shown in Figure 2.

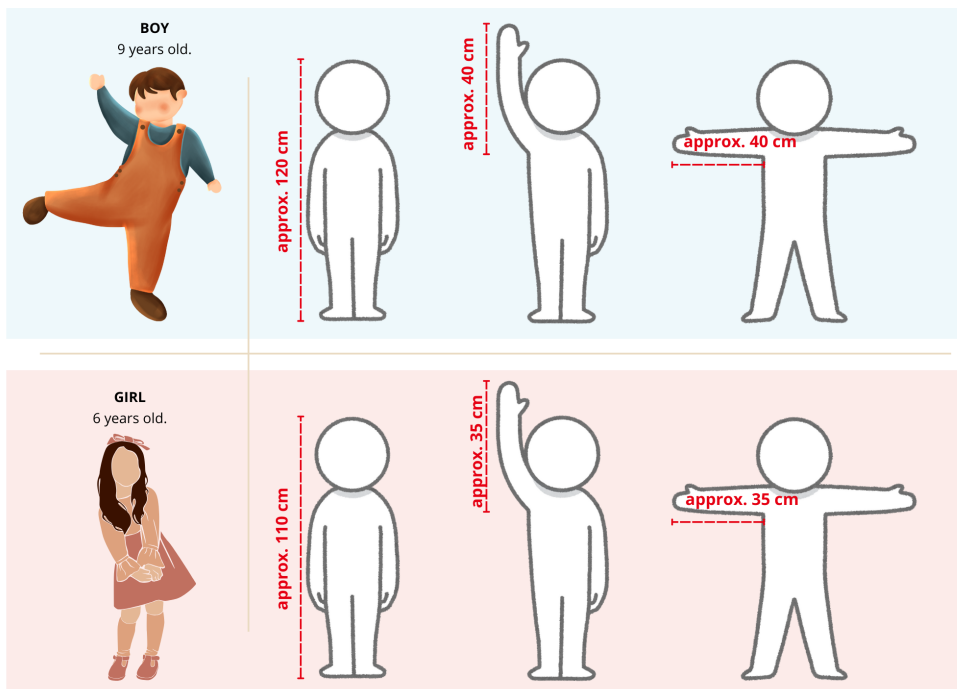


Figure 2. Building Anthropometric measurements of the participating children

All the children's activities take place under parental supervision, as the family has no support network. Although they have the help of a domestic worker, her role is limited to cleaning tasks. The children study in the morning and, in the afternoon, they take part in school and leisure activities, always accompanied by their parents or guardians. In the absence of external support, the parents reorganize their professional schedules to ensure continuous presence and alternate in caring for the children. During recreation periods, the children visit a park near the building or play in the lobby until nightfall, maintaining a fully monitored routine.

## RESULTS AND DISCUSSION

The analysis of the residential space layout was based on family usage dynamics, focusing on children, considering room dimensions, types of activities, and levels of autonomy. Based on observations and interviews, a floor plan demonstrates (Figure 3) the family's spatial organization, the functional division of rooms, and the activities carried out in each environment. In this floor plan, different colors identify each user, and hatching indicates frequency of use, allowing for comparison of spatial appropriation patterns among family members.

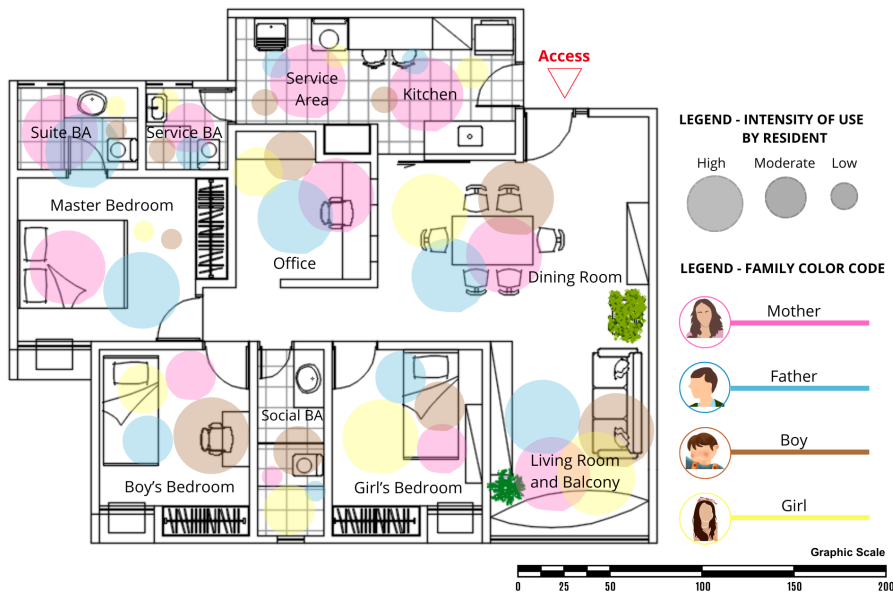


Figure 3. Floor plan of space use and occupancy by the family

The family's routine prioritizes children's needs, who frequently use the surrounding urban infrastructure, especially the neighborhood's natural park, for leisure and family interaction. Inside the apartment, there is homogeneity in the use of spaces, with social environments (living and dining rooms) functioning as collective areas, evidenced by the presence of all the colors representative of the users. In intimate spaces, such as bedrooms and bathrooms, use follows the logic of individual appropriation; however, because the children are very young, parents frequently supervise them. In the kitchen and laundry areas, the presence of risk elements, such as sharp and flammable objects, requires constant vigilance. However, the family encourages domestic tasks suited to the children's abilities. The central functions of this home space are for this family to socialize and rest, and on-site observations showed that children are allowed to cook, study, read, play, and explore the space. Figure 4 synthesizes data on the environment, activities, and risks associated with children's use, to organize information between supervised and unsupervised activities, which are directly related to the family dynamics.

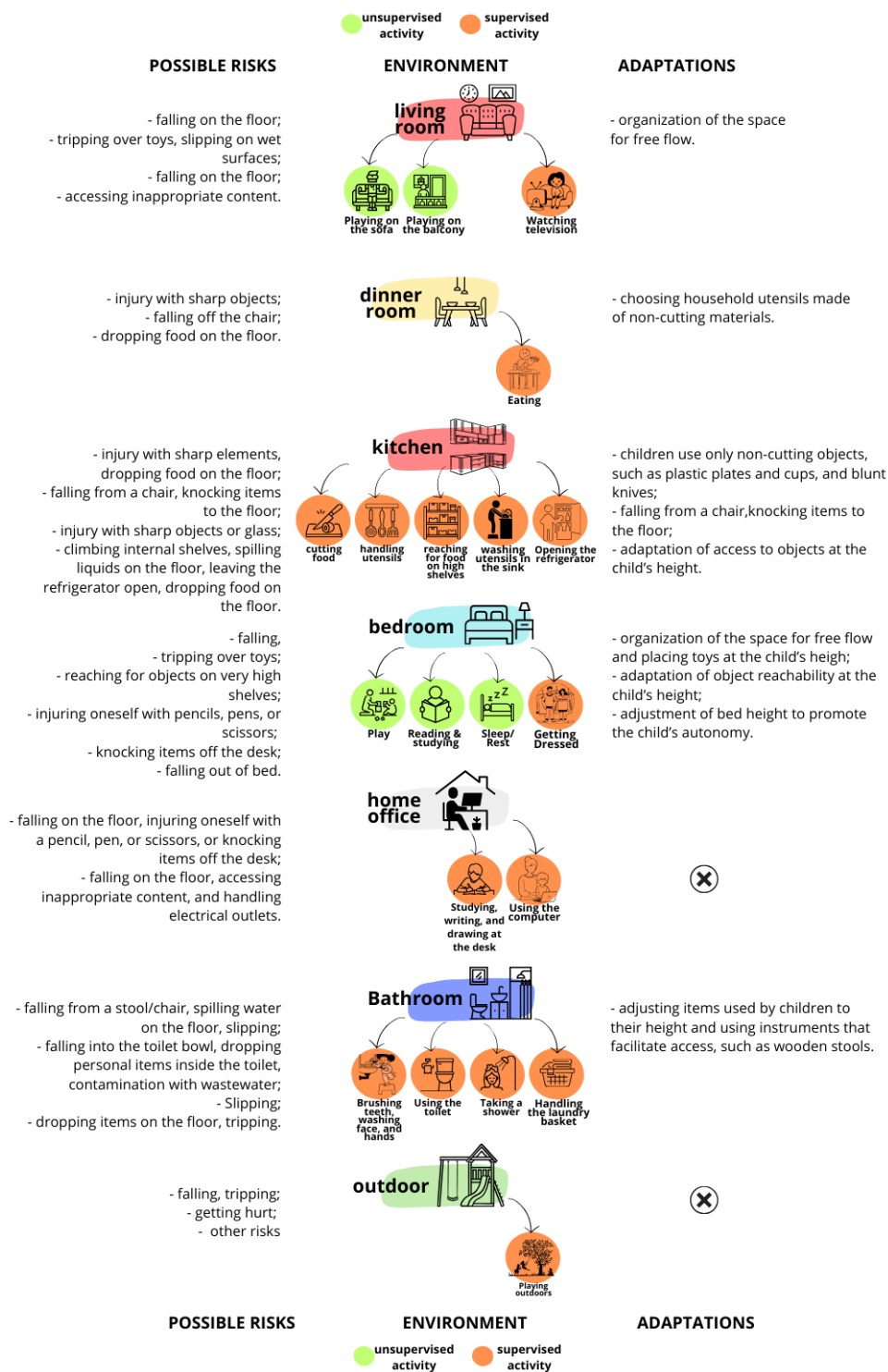


Figure 4. Activities performed by children, possible risks, adaptations, and level of supervision

## PROMOTION OF AUTONOMY AND LEARNING ISLANDS (ALI)

Data analysis reveals that specific areas of the apartment are designed to encourage children's activities in an autonomous environment. In other words, children's activities are made possible by layouts and furniture compatible with their age group (Figure 5).

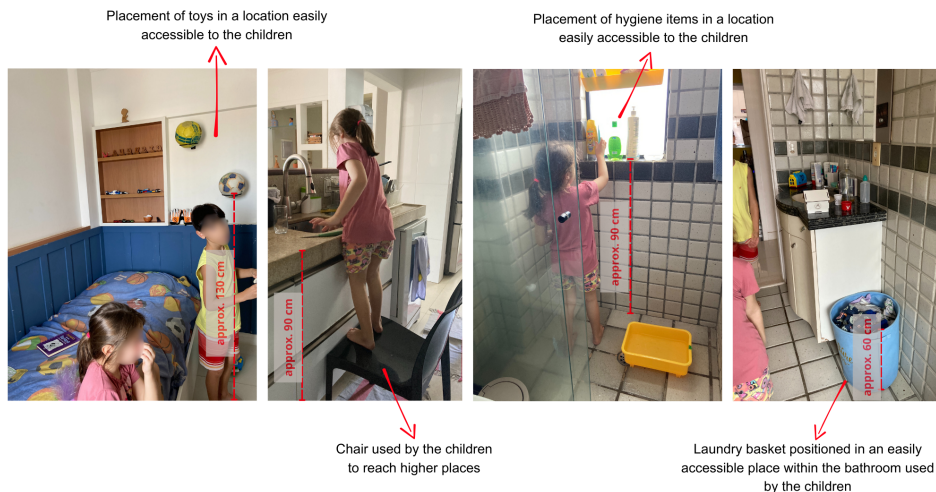


Figure 5. Adaptation of the spaces to support children's autonomy

This family dynamic promotes children's autonomy through specific layout zones inside the apartment, which we denominated - Autonomy and Learning Islands (ALI). These particular zones can be identified in the living room, bedrooms, and bathroom. Research results demonstrate these zones through isometric views of the environments (Figures 6 to 8) that detail their components and discuss positive aspects and challenges of each zone. In the living room and on the balcony, the integration of the environments promotes a necessary fluidity for socialization and family activities (Figure 6). It offers flexibility for playful practices and movable furniture, freeing up central circulation. Although the environment concept had predominantly focused on adults, there are shared elements between adults and children, fostered by comfortable seating and a hammock, which are associated with rest, reading, and leisure, and that contribute to a welcoming, multifunctional atmosphere.

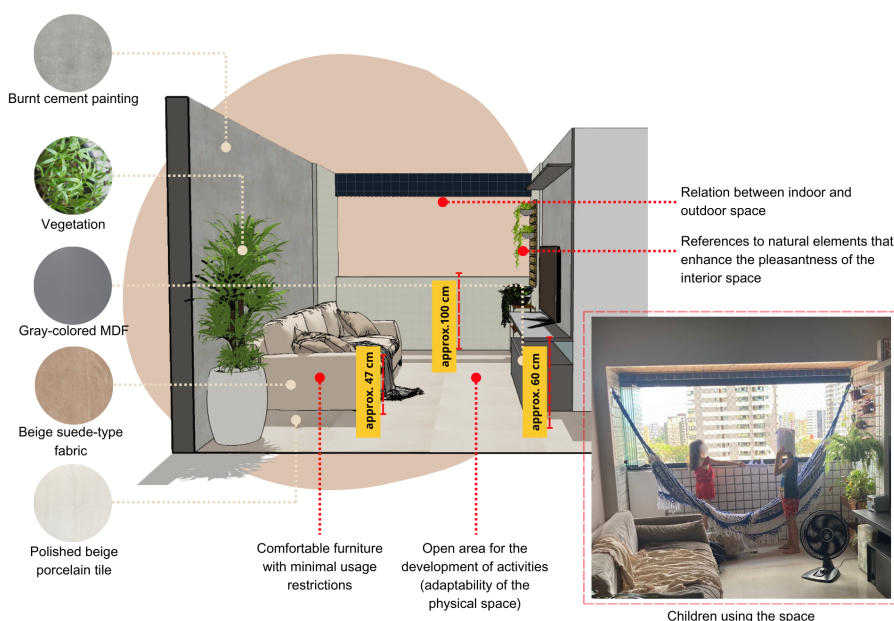


Figure 6. Isometric view of the learning and autonomy islands in the living room and balcony

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In the girl's bedroom (Figure 7), the intention to create a playful environment conducive to autonomy is evident in the choice of furniture and decorative objects. The space combines white wall coverings and furniture with pink details, resulting in a light atmosphere appropriate for the age group. The toy storage furniture is at accessible heights, encouraging independent play and environmental organization.

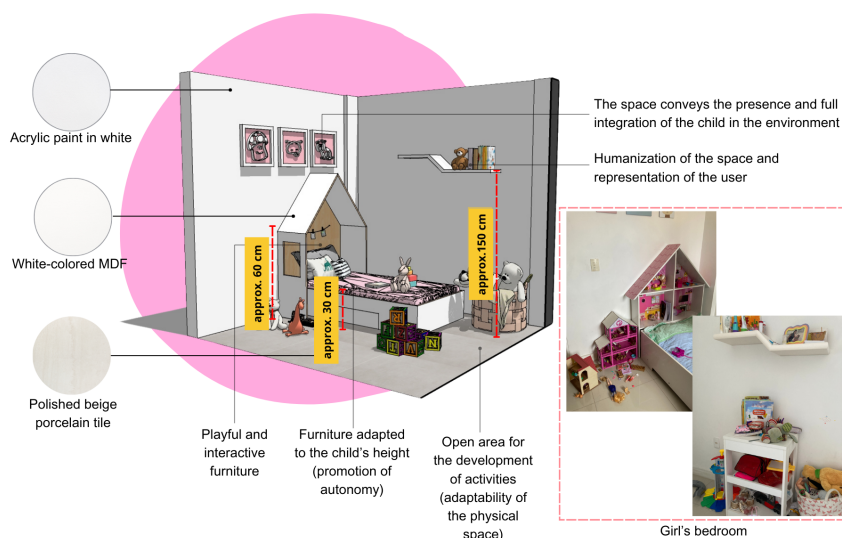


Figure 7. Isometric view of the learning and autonomy islands in the girl's bedroom

In the boy's room (Figure 8), the intention to balance leisure, concentration, and relaxation activities is evident, favored by a spatial arrangement that organizes these functions. Careful attention has been given to the choice of colors, materials, textures, and the strategic arrangement of furniture, stimulating the activities carried out in the environment. The setting incorporates references to the male universe of childhood, present in toys, decorative objects, and chromatic details, reinforcing the user's identity and creating a welcoming atmosphere appropriate for his age group.

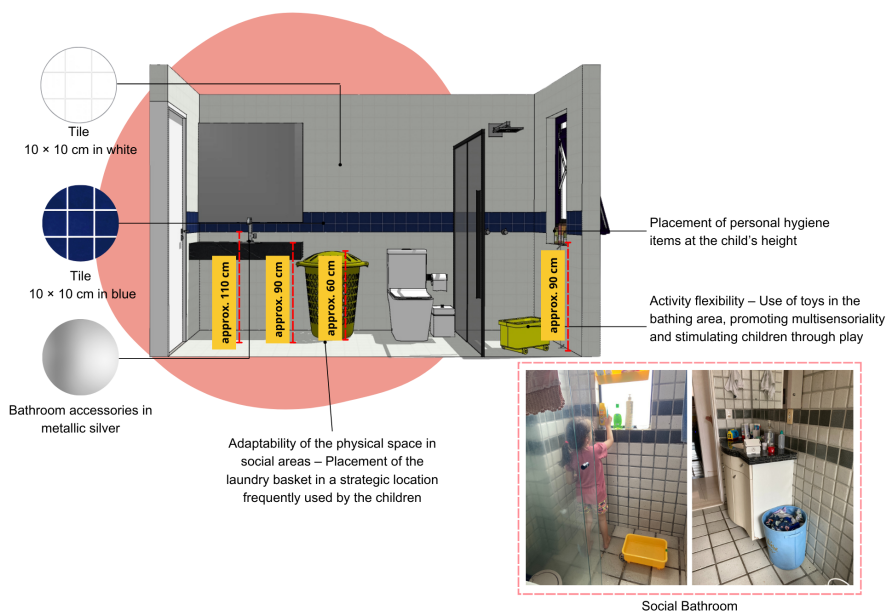


Figure 8. Isometric view of the learning and autonomy islands in the boy's bedroom

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The bathroom (Figure 9) promotes children's needs by providing free access to hygiene products. A child-height laundry basket and personal care items on the accessible windowsill (90 cm) encourage autonomy. Bath toys further enhance the space's flexibility by integrating play into the routine.

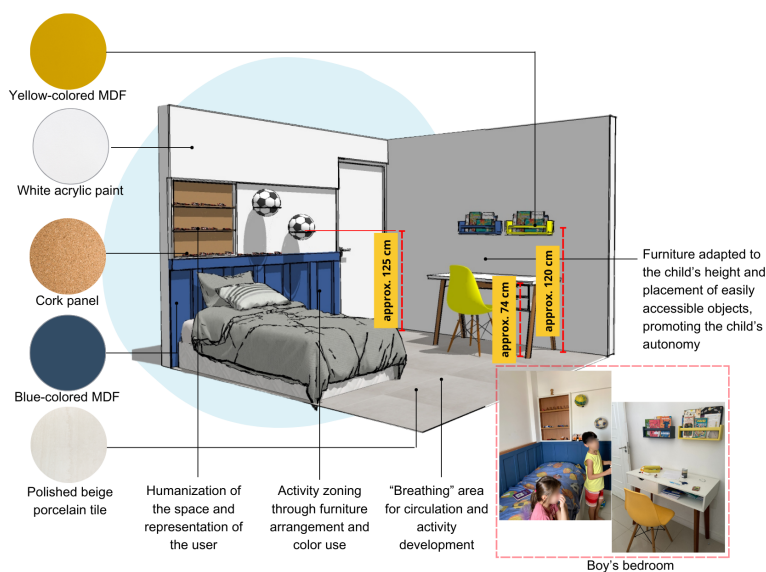


Figure 9. Isometric view of the learning and autonomy islands in the social bathroom

In terms of materials, the bathrooms adhere to the building's original specifications. The mirror, however, is installed at a height compatible with adult use, which occasionally requires a support so children can use it and reach the sink independently. This feature reinforces the need for specific adaptations that account for children's heights when planning shared bathrooms.

## DIAGNOSIS AND ERGONOMIC RECOMMENDATIONS FOR CHILDREN'S AUTONOMY

The results reveal that the environment's adaptability to children's needs is most evident in private spaces, such as bedrooms. In contrast, social environments—living rooms, dining rooms, and bathrooms—are designed for adult use, both in terms of functionality and materials. In these areas, children's participation depends on compensatory strategies, such as physical supports and mediations that reduce risks and difficulties in reaching things, highlighting the absence of an ergonomic approach that considers the diversity of users. The diagnosis identified inequalities in children's independent performance of activities, especially in environments designed for adults. To mitigate these effects, adjustments to the spatial configuration are recommended, with an emphasis on functional reach, risk signage, and furniture rearrangement to increase child safety and autonomy (Figure 10).



Figure 10. Recommendations for adaptations in the living space

Such measures do not require structural interventions and can be implemented progressively, in step with child development and with the necessary degree of supervision, offered by the family dynamic. To increase children's autonomy and safety in the home, the following strategies can be helpful (see Table 1). These recommendations aim to enhance children's autonomy, improve home safety, and foster a more responsive and equitable environment, aligning with Built Environment Ergonomics principles and children's actual needs.

<p><b>Overcoming unsafe heights</b></p>	<p><b>Use small benches or chairs</b> that allow children to reach sinks, counters, and tables safely;</p> <p><b>A visible and accessible arrangement of everyday objects</b> promotes independence in daily activities;</p> <p><b>Eliminate storing foods over high equipment</b>, such as over refrigerators or shelves, and prefer storing snacks and sweets in secure, closed cabinets and drawers.</p>
<p><b>Provide safe transportation of objects</b></p>	<p><b>Light and castered furniture</b>, such as chests, cabinets, or organizers that facilitate the transport of objects and expand the play space beyond bedrooms, encouraging autonomy and organization.</p>
<p><b>Promote socializing during meals</b></p>	<p><b>Booster seats or adaptable chairs</b> enable children to participate comfortably and integrally in family meals at the dining table.</p>
<p><b>Promote autonomy in the kitchen</b></p>	<p><b>Introduction of safe cutting and glass materials</b>, such as scissors, blunt knives, and glasses intended for children's use, appropriate for their age group, stimulating practical and cognitive skills related to food preparation, under adult supervision.</p>
<p><b>Avoid domestic dangers</b></p>	<p><b>Visual signage of risk areas</b>, with icons at child height, in the kitchen and laundry areas, such as cleaning product cabinets, the stove, the washing machine, and the trash can, promotes hazard recognition and accident prevention;</p> <p><b>Do not reuse food packaging</b>, such as bottles and ice cream tubs, to avoid misinterpretation of the contents;</p> <p><b>Provide cleaning products exclusively inside closed cabinets;</b></p> <p><b>All windows and glazed openings must be covered with a safety net;</b></p>

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Protect the power board against unauthorized access and tampering by children.
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Table 1. Strategies to protect children from domestic dangers and also offer autonomy through routine activities

## FINAL CONSIDERATIONS

In general, interior design tends to prioritize adults' preferences and needs. However, this study's results show that simple interventions, such as accessible furniture, objects within reach of children, and the creation of an Autonomy and Learning Island (ALI), can significantly expand children's capacity for exploration, independence, and creativity. By promoting environments that are more responsive to children, architecture contributes to living experiences that are more inclusive, equitable, and consistent with the diversity of users inhabiting the space. In this sense, the construction of ergonomic child-friendly spaces is strategic not only for improving the domestic experience but also for strengthening family bonds and promoting healthier coexistence. Recognizing children as active participants in the production of space implies designing environments that not only protect but also encourage exploration, play, curiosity, and integral development from the earliest years of life. As a case study, this research has limitations inherent to a small context. However, its findings point to relevant directions for future investigations, especially regarding the formulation of replicable design strategies and the evaluation of accessible adaptations across different housing typologies. Advancing in these directions can help establish design guidelines that make contemporary housing more inclusive for children, promoting domestic environments that welcome, stimulate, and sensitively accompany child development.

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