

Peer-reviewed article

Reframing Anthropometry and Ergonomics Beyond the Normative Body

An Active Learning Study in Interior Architecture Education

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User-Centered Design, Ergonomics, Anthropometrics, Interior Architecture Education, Active Learning

Abstract

Within interior architecture education, anthropometry and ergonomics constitute foundational domains of knowledge for understanding the relationship between users and designed environments. Their pedagogical application often positions the user as a body to be measured, proportioned, and accommodated within space. This study recasts that initial framing by asking how these domains can be taught beyond the normative body and how they may support a relational understanding of user, action, object, and space. The study was conducted as part of an undergraduate course, Ergonomics in Interior Architecture, at Özyeğin University during the Fall 2024–2025 semester; through an active learning exercise structured around role-playing, a case study, and a poster session. The study was conducted in the Ergonomics in Interior Architecture course at Özyeğin University during the Fall 2024–2025 semester through an active learning exercise structured around role-playing, a case study, and a poster session. Students created fictional users with non-normative bodies, mapped their daily routines, and developed spatial and furniture proposals responsive to their abilities, limitations, and needs. The research material comprised the project posters and written reflections of 10 students who completed all stages of the exercise. The data were analyzed using qualitative content analysis. The findings indicate that the students moved beyond the procedural application of anthropometric and ergonomic standards, interpreting bodily difference as a generator of design reasoning. The study suggests that by centering a non-normative user in a design problem, anthropometry and ergonomics can move beyond their conventional role as instruments of fit and become pedagogical means through which students learn to understand interior space as a relational field.

Introduction

Interior architecture is concerned with the reciprocal relationship between space and the user, where physical, functional, and experiential dimensions operate together. Thus, interior architecture education should enable students to understand the user not as a figure to be accommodated but as an embodied agent who is shaped by spatial conditions and who, in turn, reshapes them through movement, perception, adaptation, and use. In this respect, the question of how students learn to consider the user becomes a critical pedagogical concern.

The user is often introduced primarily through the category of the human body, which can be measured, proportioned, and fitted into space. This initial framing has largely been shaped by design domains, particularly *anthropometry* and *ergonomics*, which offer a framework for translating the relationship between user and space into design knowledge. Anthropometry defines the human body through dimensions, proportions, reach, posture, and measurable variations, while ergonomics extends this knowledge to conditions of comfort, safety, efficiency, and bodily interaction within environments.

Although such knowledge is indispensable for designing accessible and usable environments, it may lead to a reductive understanding of the user–space relationship when taught as a checklist of bodily measurements or problem-solving criteria. In such cases, the user tends to be reduced to a measurable body, and space to a container that should be adjusted to bodily dimensions. Rather than treating anthropometry and ergonomics as neutral principles that simply solve the problem of fit, they can be reframed as starting points for questioning how bodies encounter, inhabit, and transform space.

The pedagogical question, then, is *“How can anthropometry and ergonomics be taught without confining the user to measurable bodily data?”* Previous studies have emphasized the importance of integrating theoretical knowledge with practical applications in teaching anthropometry, ergonomics, and user-related design knowledge (Dianat et al., 2018; Sulaiman et al., 2016). These studies point to a persistent tendency: students may learn the terminology, standards, and technical expectations of anthropometry and ergonomics without necessarily developing the capacity to use them critically within design reasoning. The issue is not only whether students can apply anthropometric or ergonomic data correctly but also whether they can use these principles to question how bodies, actions, objects, materials, and spaces co-produce one another. *This study addresses this gap by questioning how these principles can be reconsidered beyond their conventional framing in interior architecture education.*

In this regard, a design exercise was developed as a part of the undergraduate Ergonomics in Interior Architecture course at Özyeğin University during the Fall semester of the 2024–2025 academic year. The exercise was introduced after theoretical lectures on anthropometry, ergonomics, and User-Centered Design (UCD). To explore how students could apply theoretical knowledge to the design process, this study adopted an active learning approach that positioned students as active participants in the learning process. Instead of asking students to apply ergonomic standards to a predefined design problem, they were required to define a fictional user with physical differences and to develop a spatial proposal in response to the user’s bodily conditions and practices.

The aim of this study is to explore how such a task can expand the pedagogical role of anthropometry and ergonomics in interior architecture education.

The study is guided by two research questions:

- *How are anthropometric and ergonomic principles interpreted when students design for bodies that do not conform to normative human proportions?*
- *How does designing for a non-normative user shift students' understanding of bodily accommodation toward a relational understanding of body, action, object, and space?*

The study hypothesizes that introducing physically differentiated fictional users into a design exercise shifts students' design reasoning from "accommodation of a body" to a relational understanding of user and space. From this perspective, the study seeks to position anthropometry and ergonomics as tools for developing critical and relational spatial thinking in interior architecture education.

Body as Design Knowledge

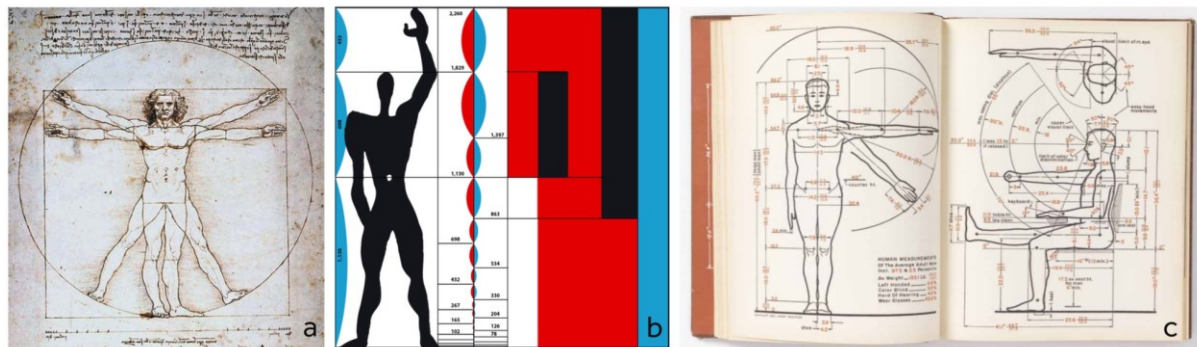
Understanding the body has long been a central concern in design disciplines. Throughout history, designers, architects, and theorists have sought to translate the human body into systems of proportion, measurement, and spatial order. Within this context, the "*ideal man*" concept has evolved through different historical and disciplinary perspectives, shaped by influential figures such as Leonardo da Vinci (1490), Le Corbusier (1954), and Tilley (1993). Leonardo da Vinci's Vitruvian Man and Le Corbusier's Modular System argued that architectural design could be improved by using the human body as a model and adhering to certain standards. For Le Corbusier, the ideal human body—*a strong, muscular, physically agile male figure*—was used as the foundation for scaling spaces to create environments. This body was seen as representative of all individuals, with anyone outside these standards considered "*abnormal*". Dreyfuss and Tilley introduced "Joe" and "Josephine" as average American users, thereby bringing the female body into the visual language of design standards. Another notable example of standardization is Neufert (1970), which remains a fundamental resource for spatial design standards and continues to be published in new editions. These references exemplify that the history of architectural and design standards is not only a history of designing for the "human body"; it is also a history of selecting certain bodies (non-disabled, average and often gendered) as the basis for universal spatial norms (Figure 1).

Once the body becomes a source of design data, however, a critical question emerges: *How can bodily measurements be translated into spatial decisions without reducing users to a single normative model?* This question provides the basis for discussing ergonomics and anthropometrics.

Anthropometry relocates the body from the field of ideal proportion to that of measured difference. The question is no longer what an ideal body might be, but how bodies vary in height, reach, posture, movement, and physical capacity, and how such variation can inform spatial dimensions. This knowledge operates through static measures (e.g., stature, sitting height, and limb length) and dynamic measures (e.g., functional reach, clearance, range of motion, and movement capacity) (Pheasant & Haslegrave, 2018). For interior architecture, these measurements provide a basis for adjusting spaces, objects, and furniture systems to diverse users, with consequences for use, safety, comfort, accessibility, and physical strain (Panero & Zelnik, 1979). Anthropometric data gain meaning in relation to use: the task, the posture, the repeated movement, and the environmental condition in which the body acts. At this point, anthropometry opens into ergonomics: Anthropometry makes bodily variation legible, whereas ergonomics considers how that variation is negotiated in situated relations between users, objects, tasks, and environments.

Figure 1

Representations of “ideal” human proportions through the lens of (a) Leonardo da Vinci’s Vitruvian Man (1490), (b) Le Corbusier’s Modulor (1954), and (c) Tilley’s Joe (1993).



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Note. Image References: Figure 1(a): Leonardo da Vinci. (ca. 1490). Vitruvian Man [Drawing]. Gallerie dell'Accademia, Venice, Italy. Figure 1(b): Le Corbusier. (1954). The Modulor: A harmonious measure to the human scale universally applicable to architecture and mechanics (P. de Francia & A. Bostock, Trans.). Harvard University Press. Figure 1(c): Tilley, A. R., & Henry Dreyfuss Associates. (1993). The measure of man and woman: Human factors in design. Whitney Library of Design.

Ergonomics concerns the adjustment of tasks, tools, and environments to human abilities, characteristics, and limitations with the aim of supporting well-being and system

performance (Human Factors and Ergonomics Society, n.d.; International Ergonomics Association, 2000). Understood as the science of fitting tasks to users, it has direct significance for the design of the built environment (Attaianese, 2017; Biswas et al., 2021; Costa et al., 2012; Olguntürk & Demirkan, 2009; Pheasant, 1991). In this sense, ergonomics carries anthropometry beyond measurement. It asks how bodily differences are lived through action, use, and spatial interaction. The concern, therefore, is not only the body as data but the user as an active subject within design practice. Bodily dimensions and ergonomic requirements gain relevance when they are read together with users' needs, limitations, preferences, behaviors, and contexts.

This brings the discussion to UCD, which frames the user not as a standardized body to be accommodated but as a central reference point in the design process. According to Norman (1988), UCD is a philosophy that prioritizes users' needs and interests, aiming to create products that are understandable and easy to use. Similarly, McDonagh-Philp and Lebbon (2000) describe UCD as a method that integrates users as active contributors to the design process, thereby enhancing user involvement. By focusing on individuals' needs, preferences, and behaviors, UCD seeks to ensure that every design decision contributes to a positive user experience (Norman, 1988).

From Design Knowledge to Design: Applied Pedagogies in Interior Architecture

Several studies have examined educational models that integrate theoretical design knowledge with practical applications in interior architecture education. These models include studio-based learning, interdisciplinary collaboration, and real-life design problems. Biswas (2022) presented a studio project in which students designed a food kiosk around the ergonomic needs of a specific user, strengthening their understanding of human activity and UCD. Safin et al. (2020) involved ergonomics and interior design students in a real-scale healthcare project that reimaged the waiting room of a mental health center, underlining the pedagogical value of co-creation and collaboration. Eilouti (2023) similarly emphasized a holistic, ergonomics-driven approach to architectural design, explaining how it supported designers' analytical, synthetic, and evaluative capacities. Deshpande (2023) further discussed the curricular integration of UCD principles, arguing that such engagement improved students' sense of responsibility and awareness of design impacts.

Although these studies introduce ergonomics and UCD through studio exercises and real-world applications, they often remain instructor-driven, with students applying predefined knowledge and methods. In contrast, this study frames active learning as a catalyst for developing UCD awareness by involving students directly in knowledge construction.

Active Learning as a Pedagogy

The conventional model of education, based on passive learning, is no longer sufficient (Flynn & Vredevoogd, 2010; Scott-Webber, 2012). Instead, students are increasingly positioned as active participants in the learning process. Rather than being passive listeners, students are supported in learning through doing and engaging directly in inquiry, experimentation, and practice (Bonwell & Eison, 1991). Learning occurs when individuals restructure and reconsider the information they have acquired about a phenomenon (Biggs, 1999). Accordingly, active learning emphasizes student involvement through dialogue, inquiry, and critical thinking, encouraging learners to discover, reframe, and transform knowledge, leading to deeper learning experiences (Enomoto et al., 2022; Hernández-de-Menéndez et al., 2019). Prince (2004) defines active learning as any instructional method whose core elements are student activity and engagement in the learning process. This emphasis on active student engagement resonates with Dewey's (1963) view of learning as driven by curiosity, imagination, and experimentation. Sgambi et al. (2019) further demonstrated that active learning pedagogies can enhance creativity and critical thinking in higher education contexts compared to passive instructional approaches.

Building on these perspectives, this study aims to move beyond the transmission of theoretical knowledge and the application of predetermined design knowledge. Instead, it actively involves students in exploring user diversity and questioning normative assumptions about the body and everyday life. Anthropometry, ergonomics, and the UCD approach cannot be fully developed through the transmission of definitions, standards, or general design principles alone. For these areas to become meaningful in design education, students need to encounter them as part of a design complexity in which bodily dimensions, use conditions, and user needs are interpreted together. Such a process requires students to observe, question, compare, test, and revise their decisions rather than simply apply predetermined criteria. Through this engagement, theoretical knowledge begins to operate as design reasoning: Measurements are related to lived bodies, ergonomic requirements are reconsidered through actual use, and the user becomes a critical reference in shaping design decisions. In this sense, the pedagogical structure of the study is grounded in active learning, as it enables students to transform abstract knowledge into situated, reflective, and user-responsive design practice.

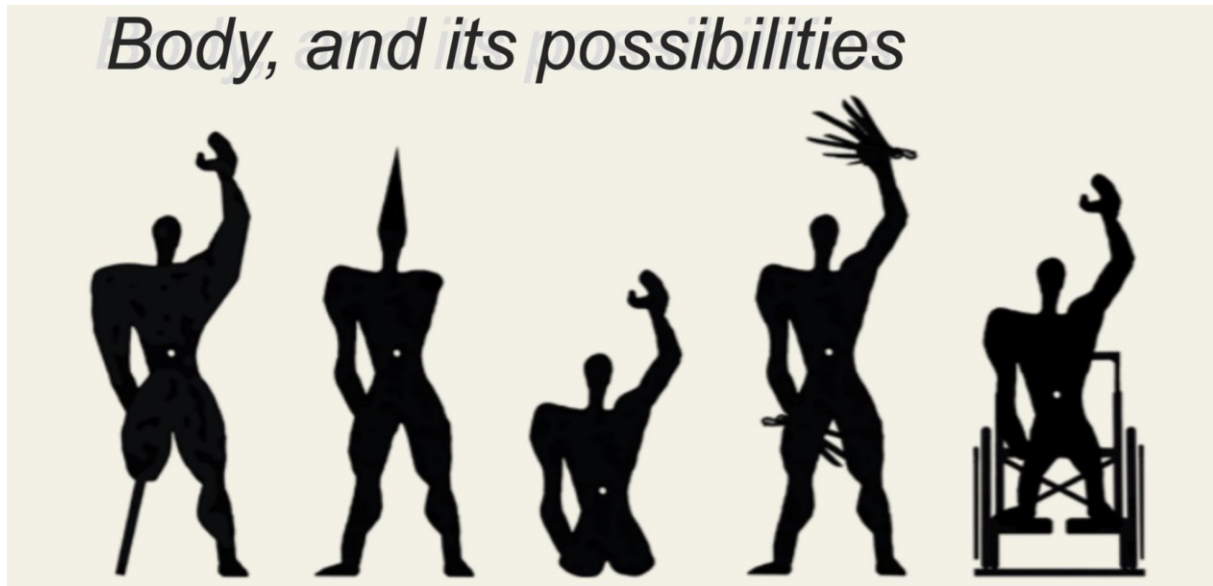
A Design Exercise as a Catalyst for Active Learning

A design exercise was developed to guide students from theoretical understanding toward a design experience. During the first five weeks of the semester, students were introduced to the theoretical foundations of human factors in interior architecture by exploring anthropometry, ergonomics, and UCD. At the end of the fifth week, a design exercise was

given to enable students to synthesize these topics and apply them to a concrete design problem. Through this exercise, students were expected to move beyond knowledge acquisition and to translate what they had learned into design decisions informed by bodily diversity, ergonomic considerations, and user-oriented thinking.

Figure 2

Body, and its possibilities (Lupton, 2014).



Note. Image References: Lupton, E., Carpentier, T., & Lambert, T. (2014). *Beautiful users: Designing for people*. Chronicle Books.

Ellen Lupton's book *Beautiful Users* (2014) provides a critical perspective on Neufert. The body is not standard; it can be tall, short, fat, thin, wizened; formed differently (Figure 2). Adopting a similar approach, students were tasked with creating fictional users with diverse needs and designing living spaces tailored to those specific requirements. Students were expected to question the "standard body" concept and redefine its discourse.

Using role-playing as an empathy-based simulation technique, direct engagement with character conceptualization lays a foundation for empathy-driven design, allowing students to deeply understand user needs and creatively translate those insights into meaningful design solutions. Case study strategies were operationalized by analyzing personas and their daily routines as contextualized design problems. Finally, poster sessions were used to support peer learning and reflection, enabling students to present and discuss their design processes and outcomes in a collaborative setting. Based on these three strategies, the design exercise was structured, and students were invited to investigate non-normative bodies and diverse user needs by creating fictional users (Figure 4).

Figure 3

Adopted active learning strategies.

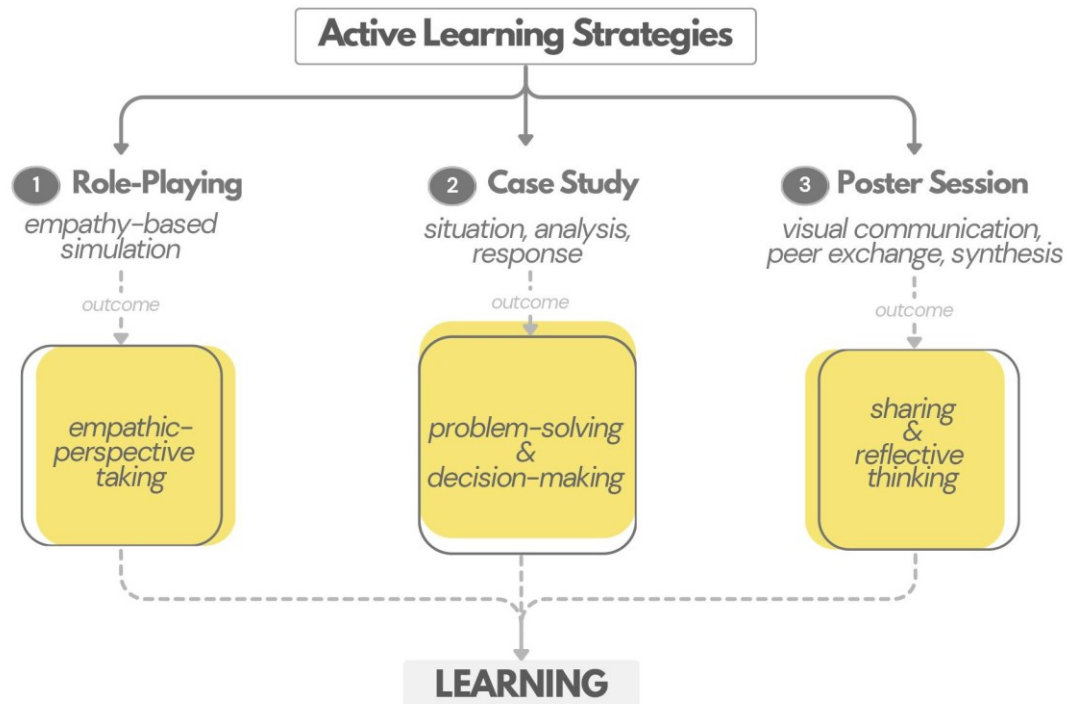


Figure 4

Design exercise brief.

ERGONOMICS IN INTERIOR ARCHITECTURE - 2024-2025 FALL TERM

DESIGN EXERCISE

Dear Students,
Within the scope of this exercise, you are expected to create a character with a physical difference and design a space/unit/furniture that is suitable for this character.

This exercise is organized around three main steps. These steps are intended to guide your process, but they do not have to be followed in a fixed sequence. You may begin with whichever step feels most accessible, relevant, or productive for your own line of inquiry.

- 1 Definition of the user:** Either select character(s) with physical differences or develop a fictional character. The physical characteristics that may influence the design process—such as body structure, body dimensions, or specific bodily organs—should be visually represented. Relevant anthropometric data for the character should also be provided.
- 2 a. Daily Routines and Storyboard:** Illustrate the selected character's daily routines and movement patterns, and develop these drawings into a storyboard. The storyboard should show how the character moves through space, which areas they use, how they change position, how they interact with objects.
b. Space/Unit/Furniture Design: Define the type of living environment the selected character will inhabit and develop a space, unit, or furniture design accordingly. The design should respond to the character's physical abilities, bodily measurements, and relevant anthropometric data, while supporting ergonomic use in daily life. Students should clearly explain how their design decisions address the character's physical differences and contribute to a more accessible and comfortable living environment.
- 3 Holistic Reflection and Presentation:** The presentation should include visual and written explanations that show the relationship between the character and the designed environment. The final poster should communicate the overall design process.

SHEET FORMAT: A3 HORIZONTAL. Don't forget to bring the printouts of the sheets to the studio next week!

In the first step, students actively create a fictional user rather than simply receive theoretical knowledge about users. From a non-anthropocentric design perspective, they

explore the character's physical appearance, bodily dimensions, and needs. Through this process, they try to take the role of another being, observe actions from their point of view, and understand feelings of them.

In the second step, students place the character in daily life through a case study that involves problem-solving and decision-making. By describing daily routines and preparing a storyboard, they simulate lived experiences and consider cause-and-effect relationships within the character's environment. These insights are then used to develop concrete spatial design solutions. Reflective thinking supports this process as students revise their designs based on experiential knowledge gained through character creation and storyboarding. The final step involves iterative doing: transforming theoretical knowledge into tangible and functional spaces that respond to the character's needs. At the end of the week, the students submitted their exercises.

After submission, the students presented their work to classmates and instructors in a collaborative setting. In line with active learning, instructors acted as facilitators rather than direct transmitters of knowledge. They guided the process through questions, encouraging students to discuss and reflect on their design decisions rather than making direct judgments. Following the presentations, students completed an online survey to reflect on their experiences and explain the reasoning behind their design choices.

Methodology

The study was based on two complementary data sources: the students' posters and their written reflections. Out of 50 students, 10 completed all stages of the exercise, including poster submission, presentation, and completion of the online survey. The analysis was therefore confined to the work of these 10 students, who were informed of the intended use of their project submissions for research purposes and provided written informed consent for their anonymous inclusion. Accordingly, all student work presented in this study is anonymized.

The students' posters were systematically analyzed, also the responses to three open-ended questions administered through the online survey provided a complementary account of students' experiences. The students' posters were systematically analyzed, also the responses to three open-ended questions administered through the online survey provided a complementary account of students' experiences. Both the posters and the textual responses were analyzed using qualitative content analysis. The analysis was conducted independently by two researchers, who coded the data and compared their interpretations to enhance the credibility and consistency of the findings.

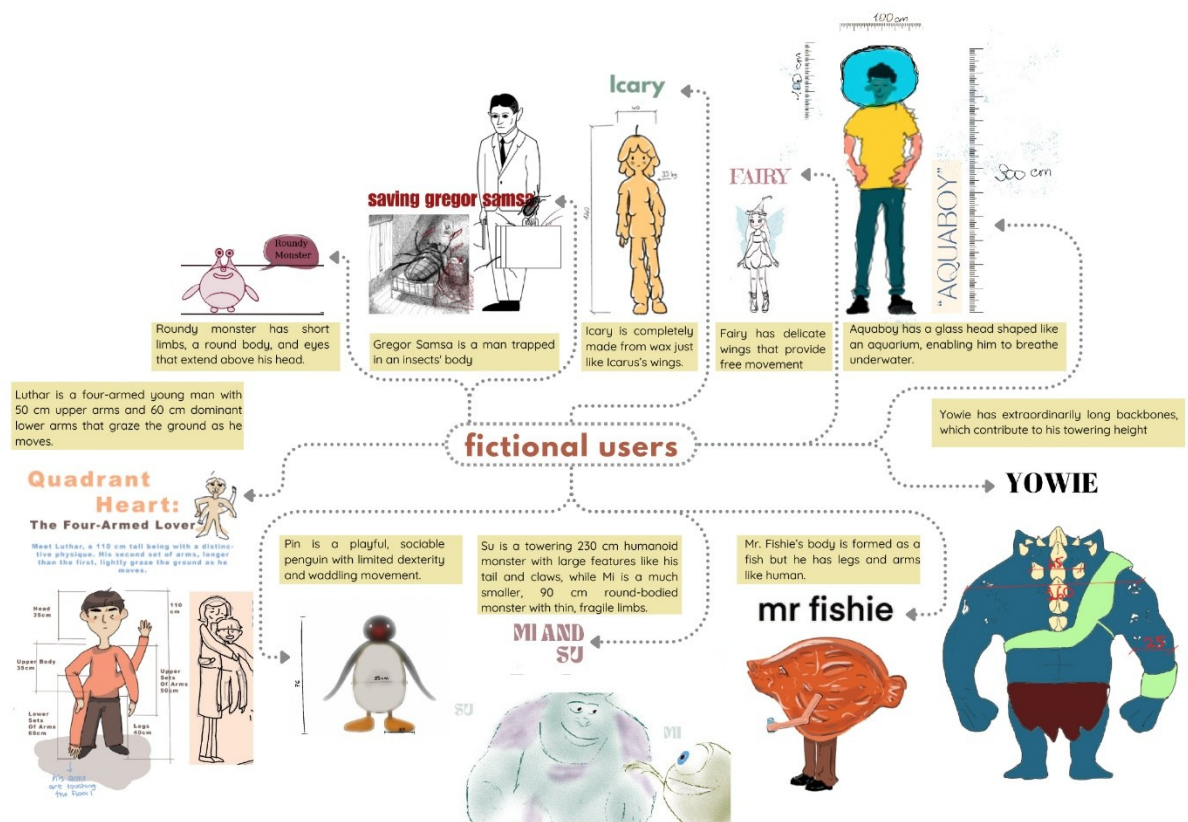
Findings

Findings on Posters as Visual Narratives

In the first phase of the poster analysis, 10 posters with different fictional users (Figure 5) were visually analyzed to identify narrative logic. The analysis focused on the visual and textual elements through which the students explained their design thinking. Drawings, diagrams, plans, sections, collages, annotations, user scenarios, and body-related representations were read together as part of the analytical process.

Figure 5

A chart of 10 fictional users with diverse features.



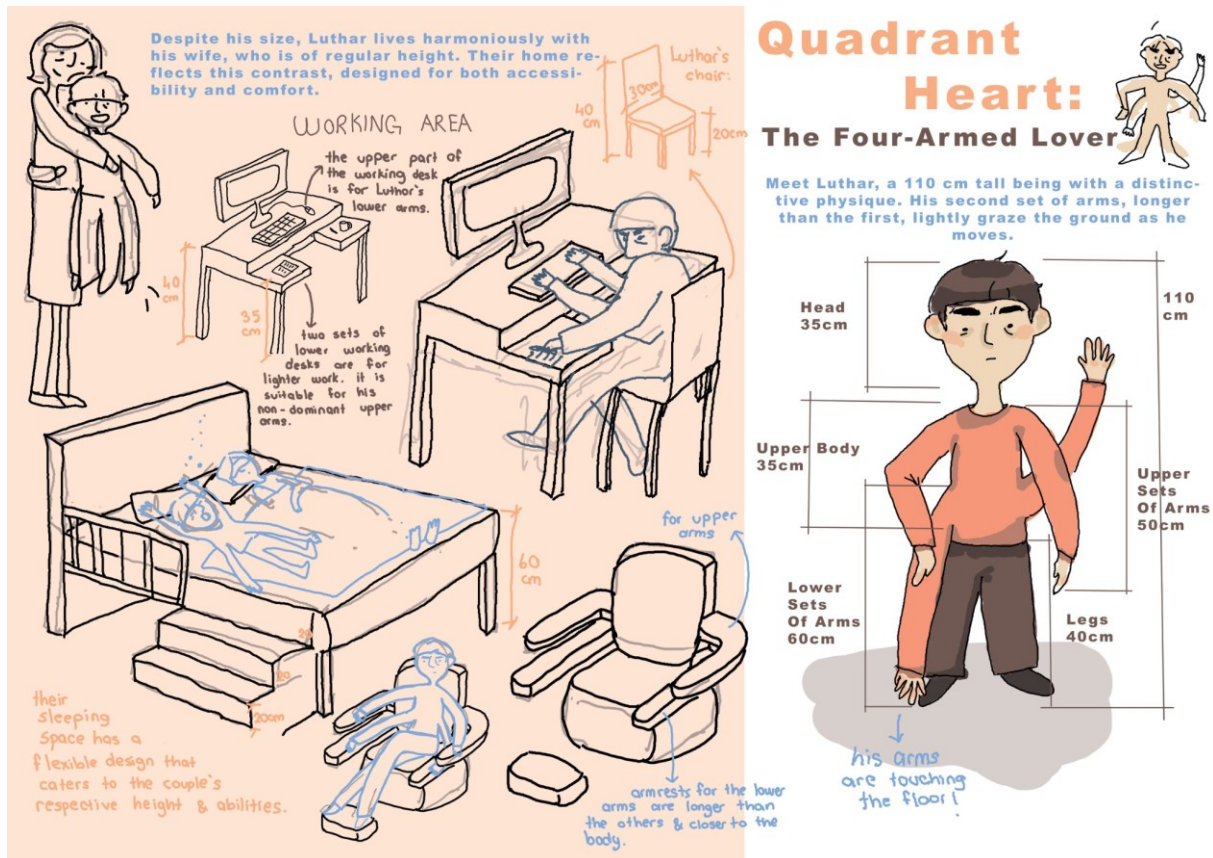
Project by Student 1: Quadrant Heart: The Four-Armed Lover

This project begins with a social situation and an unusual body. Luthar is 110 cm tall and has two sets of arms whose lengths and positions create different zones of use. These bodily features are also presented in the context of his life with a wife of typical height in a shared domestic setting. The project does not imagine an isolated environment for Luthar alone. It adjusts the home around a couple whose

bodies do not meet the same standards. The sleeping space is designed in parallel with the logic of cohabitation; the bed is described as flexible enough to address the couple's different heights and abilities. In the working area, the desk is designed so that Luthar's lower arms can operate at one level, while his upper arms remain available at another. The chair and the couch also respond to this bodily configuration with supports that acknowledge the different positions of the arms.

Figure 6

Project by Student 1: Design for Luthar: "Quadrant Heart".



What stands out in this project is the relationship between bodily measurements and shared use. The social context gives the ergonomic adjustments to their meaning. The project's main focus is this domestic recalibration, in which comfort is the goal for two unequal bodies through dual heights, differentiated supports, and furniture that accommodates more than one bodily scale.

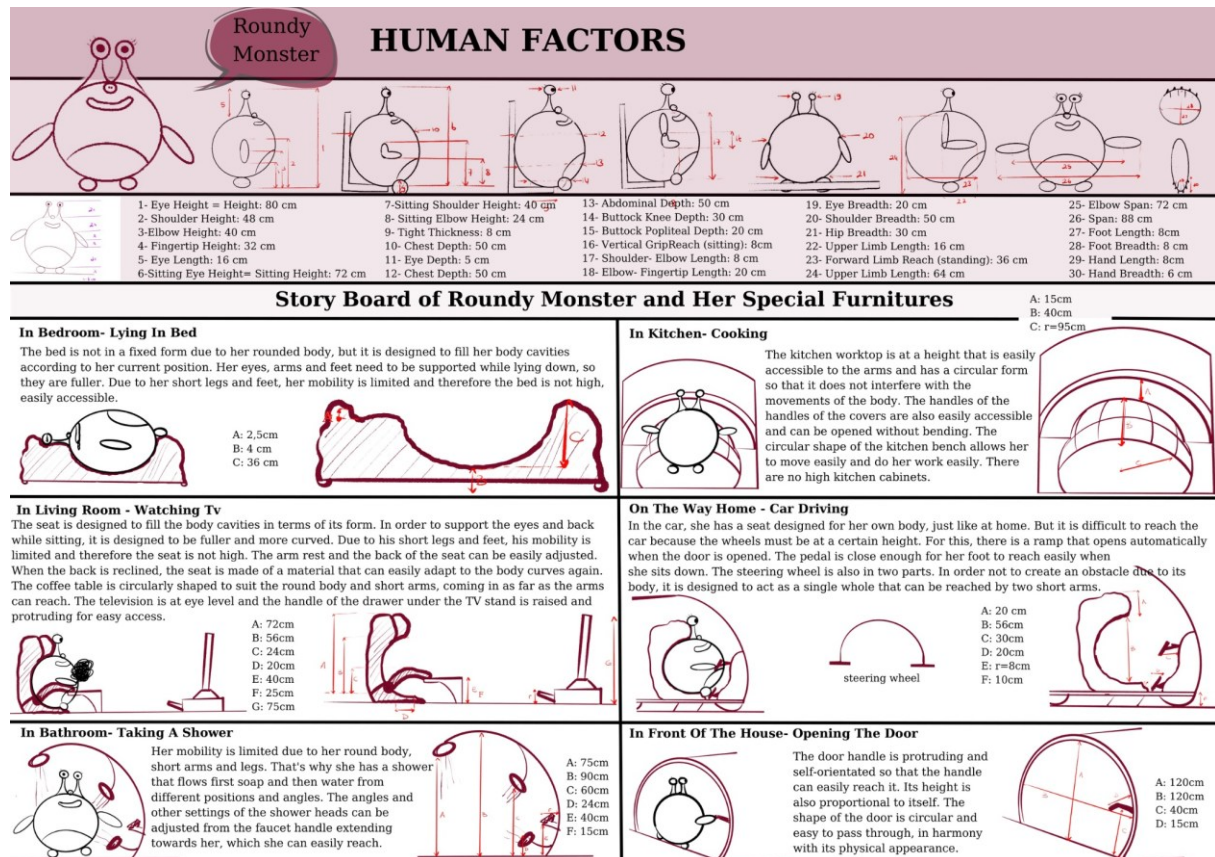
Project by Student 2: Roundy Monster

The *Roundy Monster* project starts with the body as a measured form. Roundness, short arms, short legs, reduced reach, and restricted mobility are the main conditions through which the student reorganizes the domestic setting. The proposal does not imagine a new

habitat for the character; it adjusts familiar furniture and daily-use elements so that the rounded body can use them. The bed and seat are shaped to receive the body's contours rather than forcing the character onto flat surfaces. The circular coffee table, curved kitchen counter, lowered furniture, reachable handles, close pedals, extended shower controls, and automatic car ramp all follow the same bodily logic: Familiar objects are brought within the body's actual range of motion.

Figure 7

Project by Student 2: Roundy Monster.



The relationship between body and spatial decisions is direct: The body's short reach determines where handles, controls, and surfaces must be placed to allow lying, sitting, cooking, washing, opening, watching, and driving to occur comfortably. Contextual and environmental aspects are not developed as a primary layer; the focus remains on bodily proportions, spatial adjustment, and practical use.

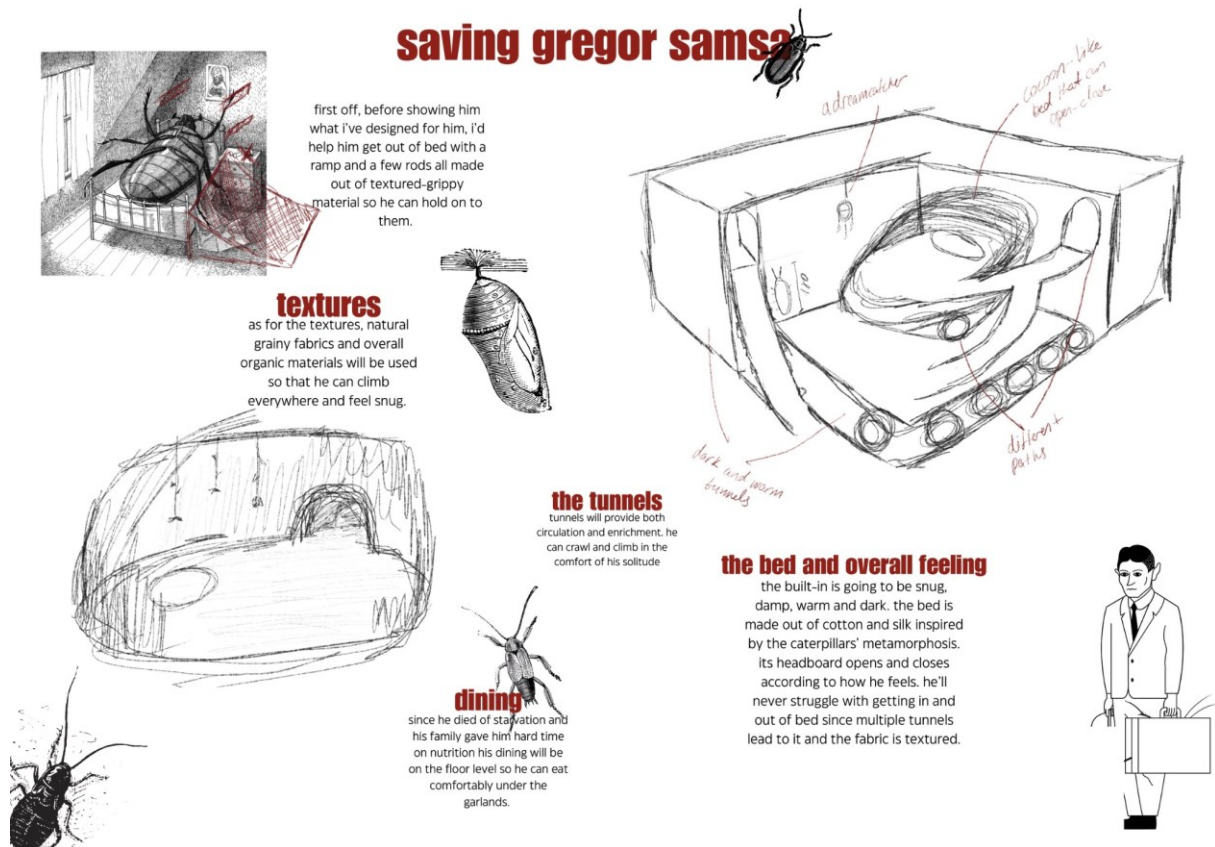
Project by Student 3: Gregor Samsa

This project is based on Gregor's human-to- cockroach transformation. Although his body is no longer human, it is trapped within a room, bed, and domestic order originally designed for a human occupant. Therefore, the project narrative begins with a displaced body that

must relearn inhabitation after metamorphosis. Gregor has to get out of a human bed, crawl instead of walk, grip instead of hold, eat at floor level, and move via low, enclosed routes rather than upright circulation.

Figure 8

Project by Student 3: Gregor Samsa.



Ramps, rods, tunnels, floor-level dining, and the cocoon-like bed translate this altered bodily agency into spatial terms. Grippy textures, organic fabrics, a damp atmosphere, darkness, and snug enclosures respond to the new insect-like body's environmental needs. Bodily dimensions appear only as a secondary cue in the diagram because Gregor's body is not described through precise dimensions; it is understood through the conflict between his former human environment and the capacities of his transformed body.

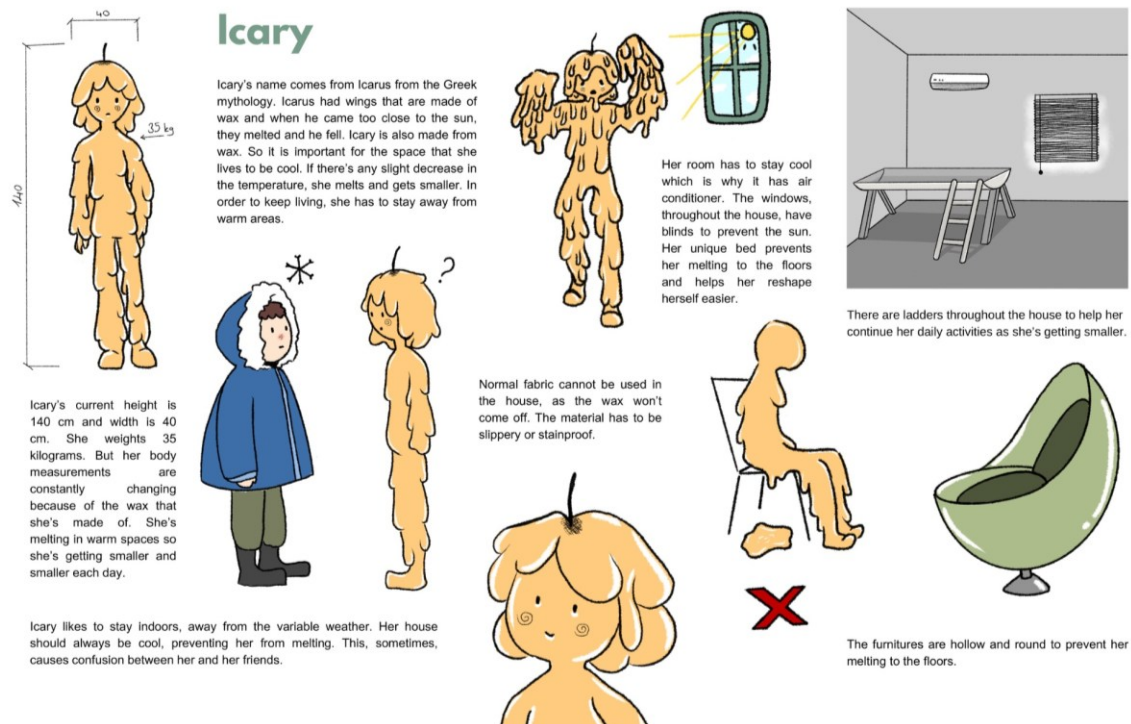
Project by Student 4: Icarly

Icarly's wax body is depicted as a thermally unstable and materially vulnerable entity that cannot be-thought apart from sunlight, surface contact, or adhesion because these conditions do not merely surround the body; they alter its size, form, and capacity to act.

Height, width, and weight therefore lose the fixity typically assumed in anthropometric design and become provisional states that must be continuously protected. The interior accommodates this instability through a cool room, blinds, air conditioning, hollow rounded furniture, ladders, and stainproof surfaces. These elements function as a coordinated system of environmental control. The furniture design is particularly significant, as it reduces surface contact and prevents Icarus's body from melting into or sticking to the furniture.

Figure 9

Project by Student 4: Icarus.



In this project, spatial form and bodily use are mutually produced; the body's vulnerability shapes the room, and the room, in turn, preserves the body's ability to continue daily routines. The resulting experience is an ergonomics of bodily comfort: a cool, safe, non-stick environment in which the body can remain intact enough to inhabit space.

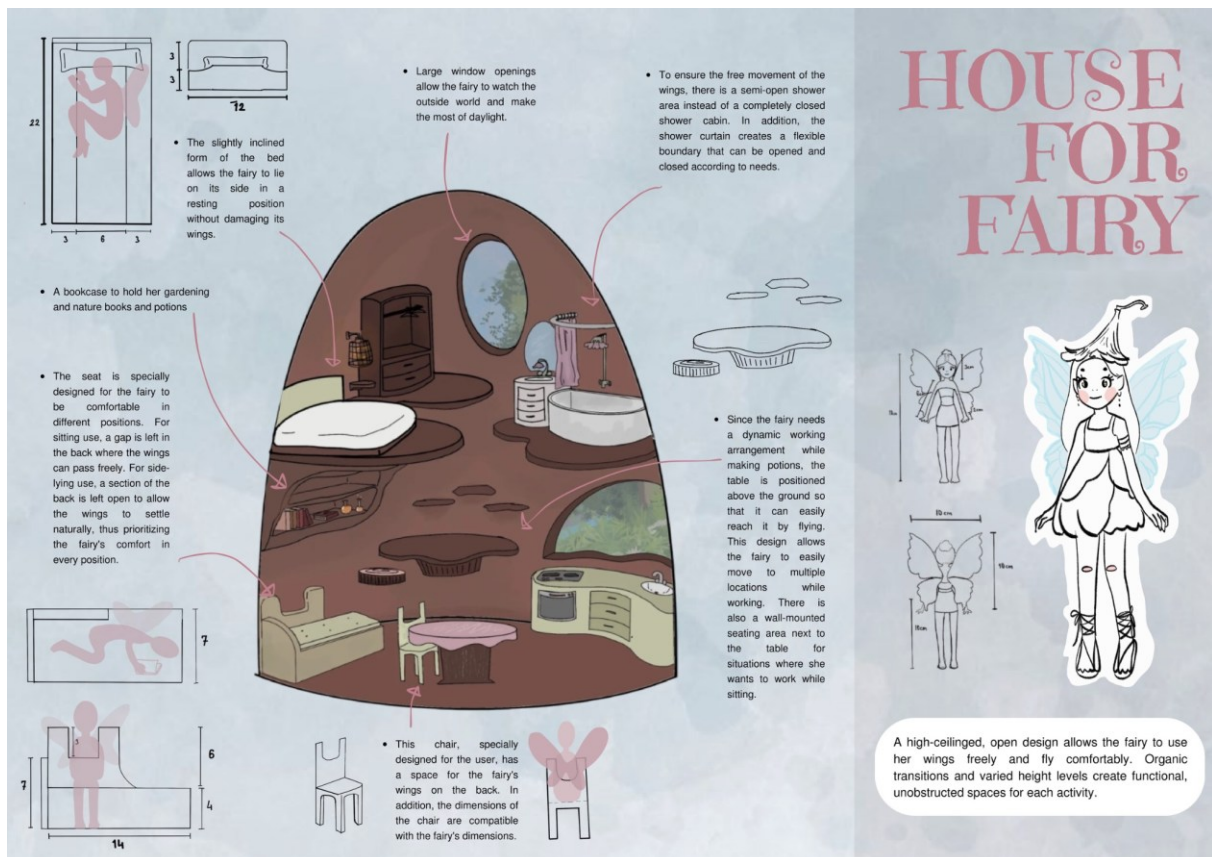
Project by Student 5: Fairy

The *Fairy* project derives its logic from the relationship between a small, winged body and its specific mode of movement. Because Fairy's body moves by flying across different heights, the design shifts away from a floor-bound understanding of use. Open levels, high ceilings, and unobstructed transitions allow the wings to remain active. The chair's back opening, side-resting bed, semi-open shower, and elevated work surface each respond to the need for lateral and vertical bodily freedom. Daylight, large openings, and nature views introduce

an environmental layer to the proposal, but they remain secondary to the ergonomic argument because they do not function as climatic determinants. Their role is to clarify the interior–exterior relationship and strengthen the spatial openness that supports Fairy’s movement.

Figure 10

Project by Student 5: Fairy.



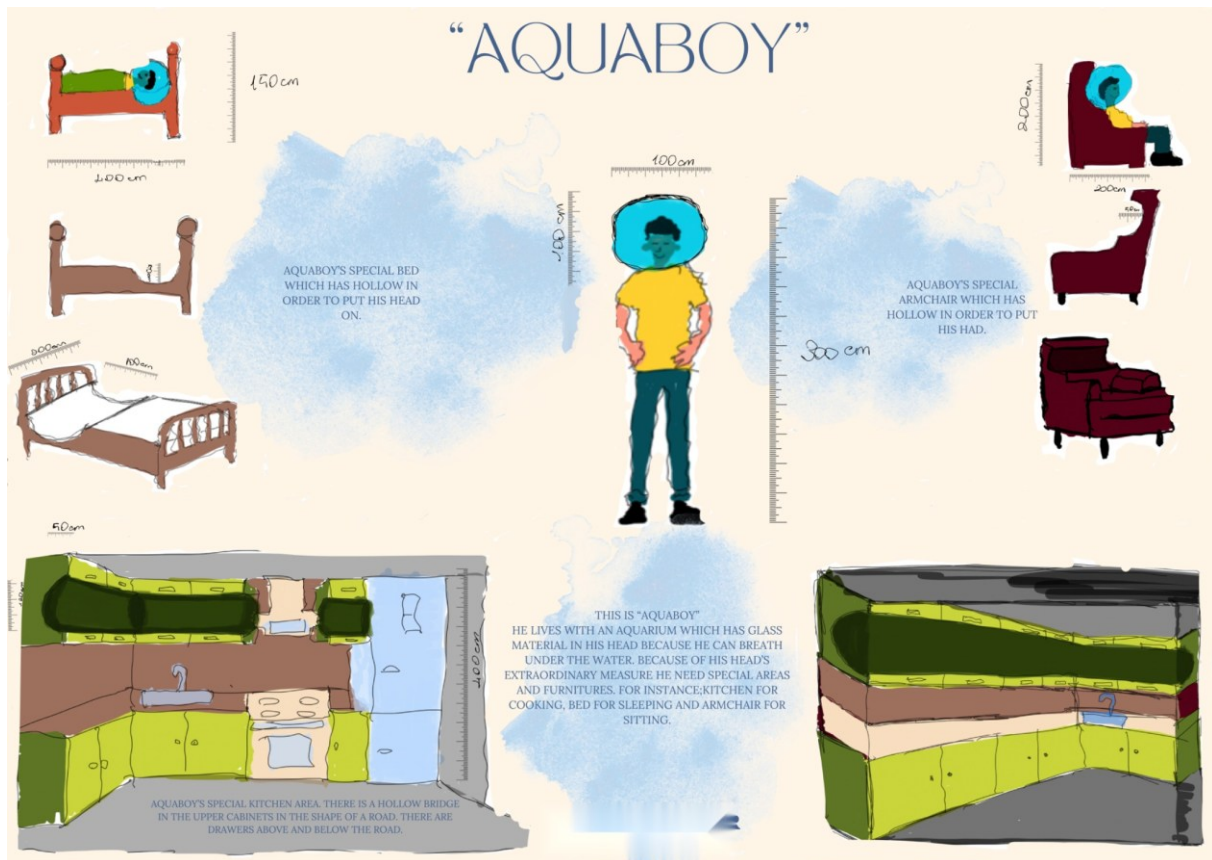
In this project, the overall space is designed as inseparable from the winged body and its movement, and ergonomics is framed as the freedom of bodily movement. The interior is shaped so that the fairy can live without being forced into a ground-bound posture.

Project by Student 6: Aquaboy

Aquaboy is depicted as a man with an enlarged head that functions as both a bodily volume and a life-support apparatus. His aquarium head, which is essential for breathing, is spatially demanding because of its size, and its glass-and-water construction makes it fragile and heavy. The design does not invent entirely new types of furniture. Instead, existing domestic furniture is revised through subtraction. The bed, armchair, and kitchen are designed with head hollows, clearances, and openings that allow the head to rest, pass, and remain free while sleeping, sitting, and cooking.

Figure 11

Project by Student 6: Aquaboy.



This project places emphasis on the aquarium head, which is the body's most critical spatial characteristic. The project works through a balanced solid–void logic: The bed, armchair, and kitchen are reframed where the head requires clearance, allowing the body's most vulnerable and life-sustaining part to occupy space without strain.

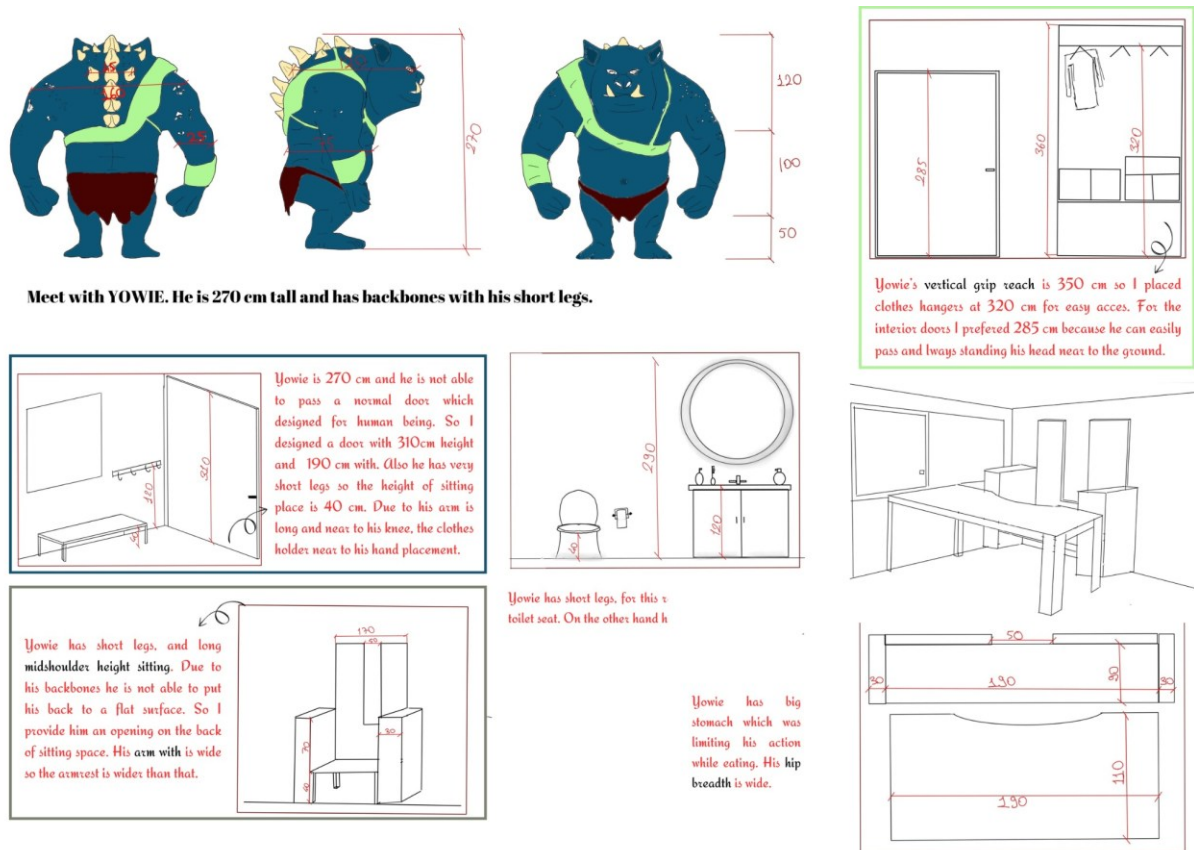
Project by Student 7: Yowie

The *Yowie* project situates an extraordinary body within a familiar, human-scaled domestic setting. Yowie's 270 cm height, short legs, long arms, wide body, large stomach, high grip reach, and protruding backbones create a body whose different parts relate to the home at different levels. The proposal responds to this layered condition by revising ordinary domestic elements individually. The heightened doors allow Yowie to pass more comfortably, and the low seat and lower toilet correspond to his short legs rather than his total height. Clothes hangers are placed within his vertical grip reach, and the chair includes a back opening so that his spine can settle without being pressed against a flat surface. The

eating area is also widened, and a clearance is left to accommodate his stomach and hip breadth.

Figure 12

Project by Student 7: Yowie.



The project treats the home as a metric framework, adjusting the dimensions of standard doors, seating, storage, bathroom fixtures, and dining surfaces in relation to Yowie's bodily proportions. The emphasis remains on dimensional adaptation rather than the development of spatial or furniture solutions specific to Yowie.

Project by Student 8: Mr Fishie

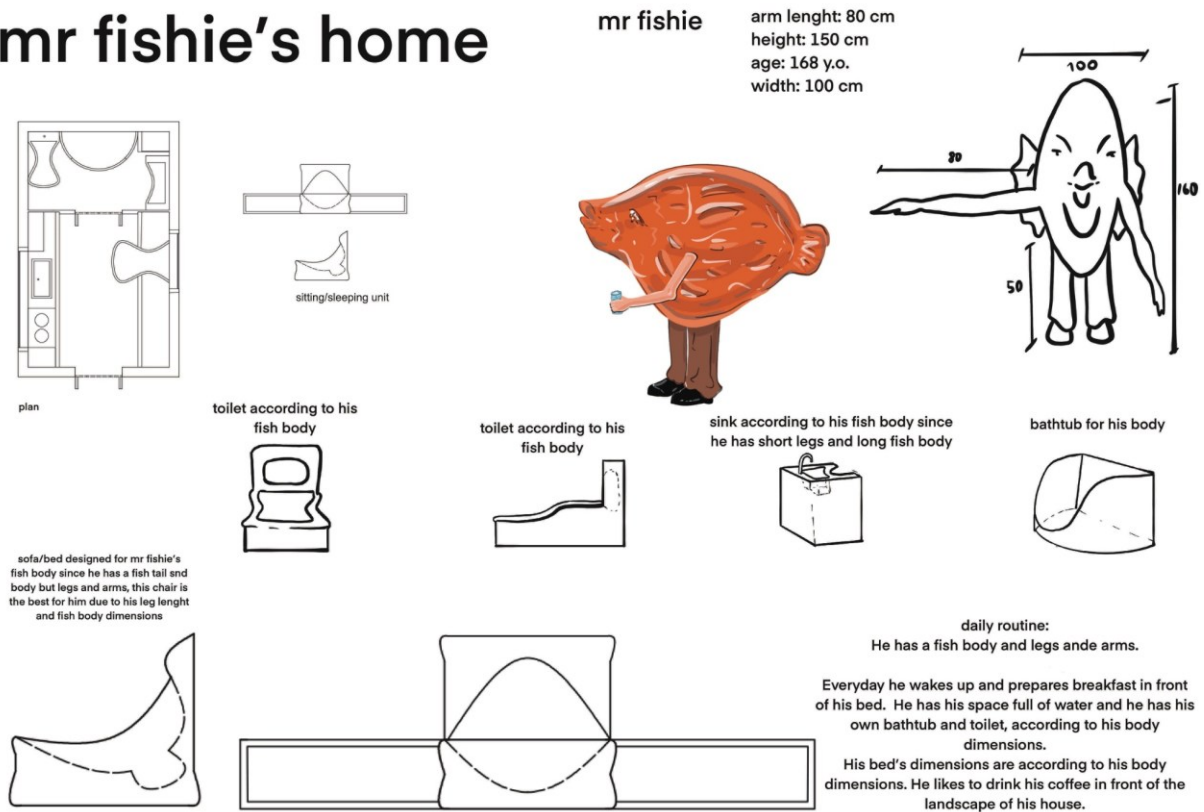
The *Mr Fishie* project developed through the introduction of the body: elongated curved torso, short legs, limited reach, and wide lateral body, which later translated into a bath, bed, toilet, sink, and sitting/sleeping unit that receive the body according to its own contours. The student does not frame Mr Fishie's condition through a broader contextual system. Despite the aquatic identity of the character, the proposal does not imagine water as a habitat. Water-related use remains attached to specific household fixtures, especially

washing and bathing. This makes the project's focus more typological than environmental: The ordinary elements of the home are recalibrated around a non-human body.

Figure 13

Project by Student 8: Mr Fishie.

mr fishie's home



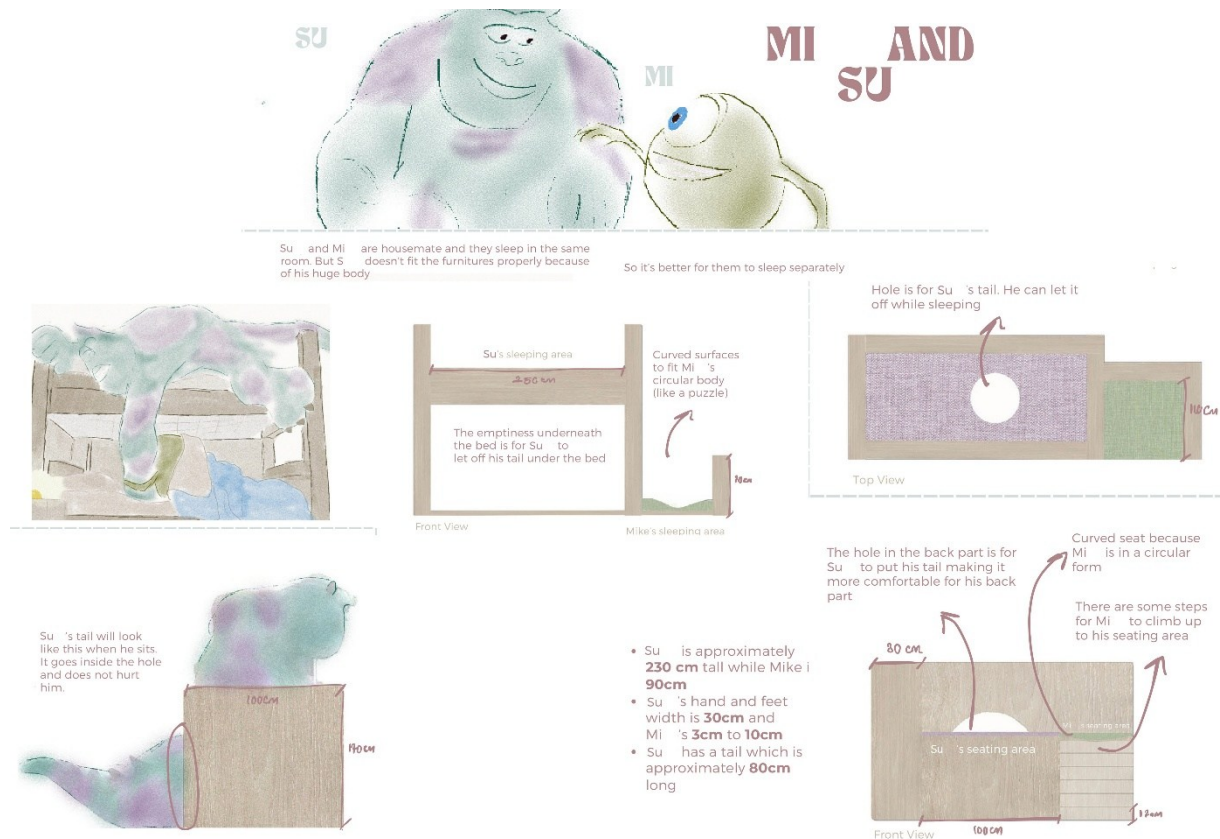
Each object is defined through the action it must sustain, such as how resting shapes the bed, washing shapes the bath and sink, bodily relief shapes the toilet, and low support shapes the sitting unit. The project's design logic lies in the redesign of domestic fixtures, where ergonomic comfort emerges through morphological fit.

Project by Student 9: Mi and Su

The Mi and Su project frames cohabitation as the central point within the context of a sleeping zone and creates a single furniture system that responds to two bodily conditions. Su's body brings considerations of length, weight, and tail extension, whereas Mi's small circular body needs a surface that can receive his rounded form and a way to reach the seat in the first place. The curved seating surface acts like a fitted pocket for his body, and the steps provide access for using the furniture.

Figure 14

Project by Student 9: Mi and Su.



The proposal translates each bodily difference into a precise adjustment. In this sense, the space remains shared, but the furniture becomes differentiated to let Su rest without tail pressure and allow Mi to climb, sit, and fit without being lost inside furniture scaled for another body.

Project by Student 10: Pin

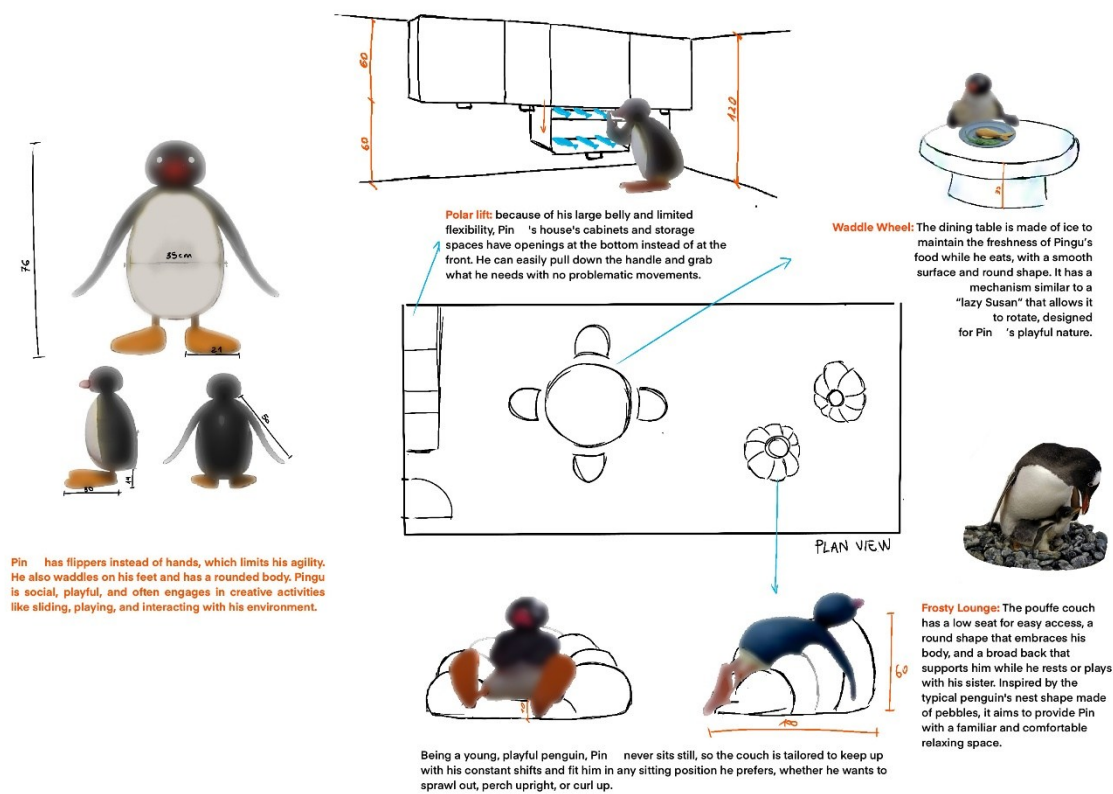
The *Pin* project begins with the character's bodily configuration: flippers, a rounded belly, short legs, broad feet, and a low body close to the ground. These features establish a body with limited grasp and reach and a movement pattern based on waddling, rotating, sliding, and frequent posture changes. The furniture is then developed around these characteristics.

The "Waddle Wheel" dining table introduces the project's consideration of environmental aspects in a localized manner. Although Pin is a penguin, the proposal does not construct a broader thermal setting for a room where coldness is a spatial climate or habitat condition.

This makes the contextual aspect present but object-based rather than atmospheric. The poster's primary logic moves from bodily proportion to movement and then to furniture designs that support daily tasks.

Figure 15

Project by Student 10: Pin.



Overall Analysis and Evaluation of Posters

When the student projects were analyzed, it became evident that the posters shared a set of recurring thematic concerns. Although each project approached the design problem through a different user, activity, or spatial proposition, their design processes converged around five analytical categories: embodied metrics, embodied experience, bodily agency, spatial configuration, and contextual aspects. These criteria emerged by examining how students interpreted the theoretical framework of anthropometry, ergonomics, and UCD within their own design processes. In other words, the criteria do not represent the design knowledge domains themselves but the ways in which students translated these domains into design thinking, spatial decisions, and modes of representation. Anthropometric knowledge was reinterpreted through questions of bodily scale, proportion, posture, and reach; ergonomic

knowledge was translated into concerns of action, movement, comfort, and use; and UCD was reflected through attention to perception, experience, materiality, atmosphere, and contextual conditions. Therefore, the five categories function as analytical lenses for understanding how theoretical knowledge about the body was transformed into spatial, material, and experiential design decisions.

Figure 16

Recurrent analytical categories in student projects.

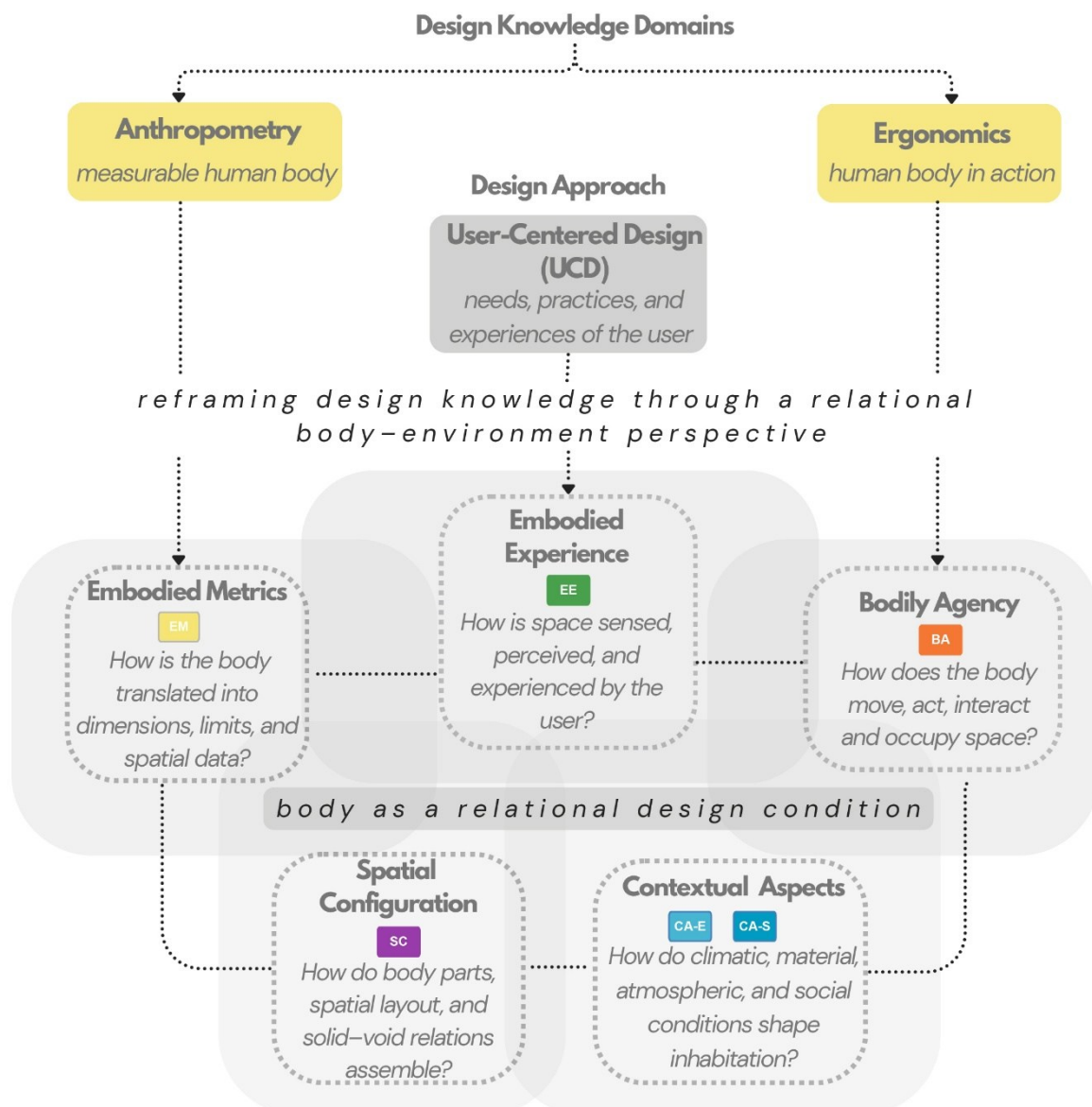


Figure 17

Design reasoning sequences across 10 projects.



Following the individual analyses of the 10 projects, the evaluation continues with project-based interpretation to an overall understanding of how design thinking is constructed

across the whole set. The 10 proposals do not approach the body through a single formula. Each one begins with a different bodily condition, environmental situation, or social relation and then develops its own sequence of design decisions. In this sense, the holistic analysis reveals students' design processes as a narrative structure (Figure 17).

The five analytical categories recur across the set, yet they do not occupy the same position in each project. In some cases, the body first appears as a measurable entity; in others, it appears as an active mode of movement or as caught within environmental or social conditions. As a result, each project establishes its own internal causality.

An overall analysis of the projects shows that *Embodied Metrics* often operates as the starting point for design thinking. The unique body first destabilizes the assumed neutrality of the generic user's body. It positions the body not as a given measure but as the condition through which the user is defined. The repeated transition from *Embodied Metrics* to *Spatial Configuration* is one of the strongest patterns in the set. This appears in different forms: A short body with four arms leads to furniture with dual heights, a round body with short reach leads to low circular furniture, or a wax body leads to cool rooms and hollow forms. In each case, *Spatial Configuration* acts as the translation mechanism of bodily particularity into furniture, void, surface, or zone.

The relationship between *Spatial Configuration* and *Bodily Agency* is frequently reciprocal rather than causal. In several projects, the anticipated action determines what the configuration must become, but the configured space also enables bodily action. For example, the head hollow matters because Aquaboy must be able to sit, cook, and sleep without experiencing a collision. Pull-down storage matters because Pin's low body, flippers, belly, and rotational movements change the ordinary relationship between storage and reach. These illustrate that *Bodily Agency* is not considered an after-use scenario. Rather, it is part of the design's formal reasoning.

Some projects follow a *Bodily Metrics-led* narrative in which bodily dimension is identified first and spatial design strictly followed. Roundy Monster, Aquaboy, Yowie, and Mr Fishie are close to this logic. Their design processes begin by recognizing the dimensional or anatomical conditions of the body and then reorganizing furniture, fixtures, or openings around those conditions. For Fairy and Pin, bodily metrics come first, but they gain meaning through agency: Wings, flippers, belly, and low body scale are translated into movement patterns. The second group follows a *Bodily Agency-led* narrative, in which the body is understood primarily through movement rather than measurement. Gregor Samsa is the clearest case because the sequence begins with climbing out and crawling before moving toward the environment. A third group follows a *Contextual Aspects-led logic*, in which the body is

already embedded in social or environmental conditions before the spatial response is formed. Within the *Contextual Aspects*, the distinction between *environmental* and *social* context is important. In Quadrant Heart and Mi and Su, Contextual Aspects appear as social conditions. The ergonomic problem does not belong only to a single body; it is produced through co-presence and bodily differences within the same space. Here, design should mediate between bodies whose needs are different and whose occupations of space may conflict or require distinct support. This approach shifts ergonomics from individual fit to relational accommodation. In Icarly and Aquaboy, the context is environmental. Heat, sun, water, and the aquarium head are conditions that determine whether the body can continue to inhabit space.

Embodied Experience occurs at the end of most sequences, which was not generally the starting claim. This appears as a consequence or final registration of whether the earlier spatial operations have worked. “Comfort for both bodies,” “curves support body gaps,” “dark snug solitude,” “safe, cool, not stuck,” “fairy moves freely,” “head rests without strain,” “spine fits without pressure,” “body feels supported,” “tail comfort,” and “soft, playful resting support” are all framed as outcomes of prior decisions.

The overall evaluation shows that the projects should not be understood as 10 separate adaptations for fictional characters but as 10 perspectives of *how domains of ergonomics and anthropometry can be implied through a user-centered approach*. What becomes critical is the difference between their sequences. When *Embodied Metrics* begins the sequence, the project tends to treat the body as a dimensional problem that must be spatialized. When *Bodily Agency* appears early, the project treats movement as a design generator. When *Contextual Aspects* appear early, the project frames the body as already dependent on environmental or social systems.

Analysis of Open-Ended Questions

Following the design exercise, the students were asked to complete an online reflection form about their experiences throughout the process, elaborating on the details and rationale underlying their design decisions. The form consisted of three open-ended questions:

Following the design exercise, the students were asked to complete an online reflection form about their experiences throughout the process, elaborating on the details and rationale underlying their design decisions. The form consisted of three open-ended questions:

(1) What was the most challenging part of the design exercise?

(2) How did this design challenge affect your approach to creating spaces for users with specific needs?

(3) As a designer, how did this assignment change your perspective towards the relation between anthropometry, ergonomics and UCD within interior architecture?

The open-ended responses provided rich insights into the students' underlying thoughts and learning experiences. Only the responses of the 10 students who completed all phases of the study (poster submission, presentation, and reflection form) were included in the analysis. The responses to the open-ended questions produced a dataset that was subjected to content analysis to discover the main concepts and relationships through a detailed examination of textual data (Creswell, 2007). The texts collected for each were analyzed separately by two independent researchers and categorized into different groups based on the phenomena that emerged. These phenomena were then compared, and each group was assigned a specific title.

Question 1: What was the most challenging part of the exercise?

Based on the content analysis of responses to the first question, two main themes were identified: (1) Physical and Ergonomic Challenges and (2) Cognitive Challenges.

The first main theme, *Physical and Ergonomic Challenges*, concerns difficulties encountered during the design process and can be analyzed into two sub-themes.

The first sub-theme is *"Designing for Non-standards,"* including fictional or exaggerated forms and altered proportions. Students referred to users such as fish, fairy, or characters with significantly different anthropometric characteristics, which required rethinking conventional assumptions. One student described this challenge as follows: *"Pin's physical features being the opposites of mine was probably the most challenging aspect... I had to think about things I never thought about before."* One added, *"I tried to understand both what Gregor would want and also what a bug would want."* Another student noted, *"The most challenging part of the design is the backbones and the asymmetric body dimensions."* Similarly, another participant emphasized difficulties related to body limitations: *"I found it a bit difficult because of the limitations of his body, he couldn't move easily."* One student explained this challenge as follows: *"Unlike typical designs based on personal or shared experiences, designing for a fictional user presented the challenge of designing without prior technical references or literature."*

The second sub-theme is *"Balancing Functional Requirements with Physical Constraints."* Students experienced challenges related to functional constraints, particularly in balancing

the physical limitations or extraordinary features of fictional bodies with the functional requirements of designed objects or spaces. For instance, ensuring usability while accommodating wings, unusual body shapes, or extreme size differences required careful negotiation between form, function, and user specificity. One student explained this tension clearly: *“The biggest challenge was ensuring the fairy’s wings could move freely without compromising functionality and comfort in the design of custom furniture.”* Another participant added, *“To think for a 110 cm tall person... designing space that accommodates his two sets of arms and his short height without changing every little aspect of the space was my main goal.”*

The second main theme, *Cognitive Challenges*, relates to the mental and conceptual difficulties students experienced while interpreting and designing for fictional users.

The first sub-theme is the *“Empathy-Based Reasoning”* challenge. Students reported that one of the main challenges was adopting the perspective of a fictional user and translating their imagined needs into spatial design decisions. This process required a high level of empathy, perspective-taking, and imaginative engagement. One student stated, *“I had to think about things I never thought about before and put myself in my user’s shoes to understand his point of view.”* Another student emphasized the role of imagination, explaining, *“I had to imagine myself as they are to understand their point of view.”* Similarly, another participant remarked, *“This task made me design for a unique character that is unlikely to exist by relying solely on empathy and imagining its daily routine.”*

The second sub-theme is the challenge of *“Ideation and Conceptual Design.”* Students reported that creating design ideas for unfamiliar and highly abstract fictional users was particularly challenging. In some cases, defining the character itself required as much cognitive effort as developing the spatial design. One student noted, *“The most challenging aspect for me was to come up with such a unique design... So the design of the character was the most time-consuming part of this assignment, rather than the space itself.”* This indicates that the abstraction of the user significantly increased the cognitive load of the design process.

Question 2: “How did this design challenge affect your approach to creating spaces for users with specific needs?”

Based on the content analysis of responses to the second question, two main themes were identified: (1) Understanding Diverse User Needs and (2) Accommodating Diverse User Needs Through Flexible Design.

The first theme, *“Understanding Diverse User Needs,”* highlights students’ increased awareness of designing according to individual needs rather than relying on standard solutions. One student emphasized that *“Every individual is special in their own sense. When designing, we must consider their needs.”* Another noted, *“The character that I designed has a very unique feature, so everything in the space needed to be designed for the user specifically.”* Similarly, another student recognized the importance of personalized solutions, stating, *“It helped me to understand how important special needs and personalised designs are for people in need.”* This awareness was accompanied by the development of students’ empathy, as understanding diverse user needs encouraged them to consider users’ experiences, routines, and perspectives in addition to their physical characteristics. Students emphasized that developing design solutions requires thoroughly understanding users and researching their specific needs. As one student explained, *“Researching about his physical needs and his routine made me empathize with him and understand him better.”* Another student described adopting a perspective-taking approach, stating, *“I will create a scenario in my head and imagine myself as they are in order to optimize the spaces according to the users’ personalities and needs.”*

The second theme, *“Accommodating Diverse User Needs Through Flexible Design,”* demonstrated participants’ awareness of the importance of flexibility. One participant stated, *“There is no such thing as one size fits all. There needs to be flexibility in design.”* Others highlighted the influence of anthropometric differences on design decisions, such as *“Due to his short legs and long upper body it was so hard to arrange the distance between units”* and the need to accommodate unique physical features: *“The biggest challenge was ensuring the fairy’s wings could move freely without compromising functionality and comfort.”* Another student reported, *“This challenge pushed me to think creatively and made me realize the importance of adjustable design,”* indicating that the experience enhanced both creative thinking and solution-oriented design strategies.

Question 3: “As a designer, how did this assignment change your perspective towards the relation between anthropometry, ergonomics and UCD within interior architecture?”

Based on the content analysis of responses to the third question, two main themes were identified: (1) Beyond Standard Measurements and (2) Interior Space as an Extension of the User.

The first theme, *“Beyond Standard Measurements,”* reflects that interior architecture should move beyond standardized dimensions and respond to users’ unique characteristics and needs. One student stated, *“Everyone has their own needs and there is no thing as one size fits all. You have to approach everything with empathy and understanding.”* Another

explained, *“It helped me understand how and why it’s important to design for the individual and remember the way not everyone is the same.”* One student reflected on the limitations of standardized measurements: *“I realised that standards do not have the same effect for everyone and that what is functional for most users is dysfunctional for the actual user of the space.”* Another student emphasized the importance of accommodating physical diversity: *“Every person’s physical attributes & dimensions directly impact their interaction with space. So interior architecture should not only consider average human measurements but also shape itself again to accommodate diverse physical forms & specific physical needs.”* This shift also led students to recognize the importance of anthropometric measurements as a basis for understanding users’ physical characteristics rather than relying solely on generalized standards. As one student stated, *“I understand the importance of a person’s need and importance of the space’s measurements.”*

The second theme, *“Interior Space as an Extension of the User,”* captures students’ evolving understanding of the reciprocal relationship between space and the body. Beyond perceiving interior architecture as merely designing the interior of a physical shell, the students began to view interior space as an extension of the user that should support their individual needs. One student expressed this perspective by stating, *“The more a design becomes a part of a person, in other words, an extension—a complement—of their body, the better the design is. It made me feel like interior architecture might be a complement of us, like structural extensions of human bodies.”* Similarly, another student emphasized this user-oriented perspective, stating, *“Different needs require different designs. Our living space needs to adapt to us, not us to it”.*

Discussion and Conclusion

This study set out to reconsider the pedagogical position of anthropometry and ergonomics in relation to UCD within interior architecture education. Beyond approaching these fields as bodies of technical knowledge that prescribe correct dimensions or functional standards, the study questioned how they might operate as critical instruments through which students learn to think relationally about the body and space.

The findings suggest that this approach generated meaningful learning outcomes. By decentering the normative body in a design brief, students were compelled to confront the fact that in design, the body is not solely a measurable entity. It is a moving, sensing, adapting, desiring, fragile, social, and environmentally dependent subject.

The study further demonstrated that active learning can deepen students’ engagement with ergonomics and anthropometry beyond the acquisition of technical information. Through

case study-based storyboarding and the subsequent design process, they connected bodily characteristics with everyday practices and translated these relations into spatial and object-based decisions. Through poster presentations and collective discussion, they externalized, compared, and revised their design reasoning. With the contribution of these stages, course content is transformed from transmitted information into a design inquiry. The pedagogical outcome of the task lies in the way it enabled students to understand and practice User-Centered Design as an iterative process of relating body, object, action, and space from an empathetic perspective.

The study drew on 10 projects and their corresponding reflections from a cohort of 50 students and focused on a single short-term design exercise, limiting the transferability of its findings. The outcomes also point to a limitation of the exercise itself, as its emphasis on a single fictional user directed students' attention primarily towards individual ergonomic requirements, while consideration of the social and collective dimensions of spatial use varied across projects. Future iterations could address this limitation by introducing scenarios involving multiple users with differing bodily characteristics, activities, and spatial expectations. This would encourage students to consider how ergonomic requirements intersect and are negotiated through social interactions within shared spatial environments. While fictional users enabled students to creatively question normative assumptions about the body, this approach should not be regarded as a substitute for direct engagement with real users, particularly in design contexts involving disability, ageing, or other lived bodily experiences. Building on these considerations, future research could examine the framework through larger cohorts, comparative studio settings, or hybrid approaches combining UCD methods with participatory engagement involving real users.

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