

Research on Spatial Utilization: Design of Foldable Furniture for Hong Kong Refugee Dwellings

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Abstract. This study addresses the challenge of poor spatial utilization efficiency among refugees by engaging in interviews to understand their needs. Through an iterative design process involving data collection, interaction design principles, and continuous refinement, multifunctional foldable furniture was conceptualized. The design underwent optimization in structure, leading to the creation of a prototype. Further engagement with the refugee community facilitated improvements, aligning the product more closely with their requirements. While the developed furniture caters to the needs of a significant demographic, limitations in universality persist. Continued enhancements are necessary to fortify its applicability across diverse refugee contexts, recognizing the inherent diversity and specific needs within this population.

Keywords: Foldable Furniture; Hong Kong Refugees; Furniture Design.

1. Introduction

1.1. Introduction of Sub-divided Units

Sub-divided units, also known as sub-divided flats, are a special type of housing found in Guangzhou, Hong Kong and other southern Guangdong areas. In Cantonese, "割" means to cut open, and "割房" means to divide an original residential unit into several smaller rental units for low-income families or individuals. Due to the high rents in Hong Kong, many people from the lower class have been living in sub-divided units for a long time. The living environment is cramped, the hygiene condition is poor, the law and order level is not good, and physical and mental health problems are common among the tenants.

1.2. Persona

(1) Research Focus

The subject of this project is a middle-aged Filipino woman residing in Hong Kong with her husband and son. Their sole financial support comes from the husband, as she lacks a work permit and, consequently, any source of income.

(2) Information Profile

Arriving in Hong Kong in 1998, the family's decision to settle was primarily driven by their desire for their son to receive quality education and grow up in a conducive environment. They currently live in a cramped 15-square-meter space in Yuen Long, Hong Kong, severely limiting available living space.

(3) Personality Traits

Throughout extensive conversations, her resilient and optimistic outlook on life became evident. She maintains composure when facing life's challenges, leading a highly structured daily routine centered around family and household responsibilities. Her deep affection for her son is palpable, especially in her support for his passion for painting.



(4) Challenges

Living in Hong Kong without stable employment poses both material and emotional challenges. Despite the parents' desire to nurture their child's interests, the constrained living space severely restricts opportunities for learning and creative expression at home. Inadequate storage space amplifies these limitations, hindering the child's learning and stifling home functionality.

(5) Motivation

Emphasizing their child's learning and educational prospects, the family seeks to provide an enhanced educational environment. They aspire to secure better opportunities and a brighter future for their child through improved education and broader career options.

1.3. Empathy Map

This study uses the dimensions of speech, thoughts, actions, and emotions to deeply understand the research subject's situation. This multi-level approach aids in analyzing their needs and tailoring the final product to meet them efficiently. The participant highlighted concerns about limited space hindering her child's studies and hobbies, emphasizing the need for a better home environment to support learning and leisure. Relocating to Hong Kong aimed to improve living conditions and access better education, prompting a desire for expanded home space and improved learning conditions. Through extensive dialogue, our team understood her desires and challenges. She stressed the significance of expanding living space to alleviate current difficulties, exploring the potential of multifunctional homes to optimize limited space and better cater to family needs. Insights from daily routines highlighted storage struggles and limited study spaces, painting a vivid picture of their pressing needs. In closing, the participant expressed frustration due to cramped living conditions, leading to difficulties in organizing and creating a conducive learning environment for her children. Her predominant emotions centered around low spirits, anxiety, and frustration when discussing these critical topics.

1.4. Journey Map

By analyzing her journey and changes in her state of mind, and combining it with her daily life and routines, we drew a journey map of her daily life. Due to the need to pray in the morning and to send her children to elementary school, she needs to wake up at 6:30 a.m. After organizing her house and cooking breakfast, she needs to begin to organize her house and clean her room, and at this time, the limited area of the furniture will cause her great distress and prevent her from working smoothly. The limited size of the furniture at this point in the day can cause her a lot of problems and prevent her from doing her job smoothly. At this point in the day, she can clearly sense where the problems lie and the urgency of getting them solved. After a busy day, she needs to pick up her children from school, cook dinner, and tutor them in their homework. Once again, she is frustrated by the limited space available in her home, and is depressed by the fact that her children don't have the proper space to study their homework and develop their interests. As the journey map illustrates, the difficulty of organizing with limited furniture and space in daily life and the lack of space for her children to study were the most anxiety-inducing and frustrating moments for her and her family, and this is the main dilemma she and her family have faced so far, as well as the most urgent problem they need to solve.

1.5. Make Sense of Data

From our interviews with Rosalie and her son, we condensed key insights into sticky notes, sorting them along two dimensions: Rosalie, a middle-aged Filipino woman, resides with her son in a cramped space of less than 10 square meters, devoid of kitchen and furniture, containing only a toilet, a bed, and a chair. Her daily routine revolves around her son's care and education, starting with early morning prayers, breakfast preparation, school drop-offs, market visits, household chores, and assisting with his homework. Her commitment echoes her aspiration for her son's improved education and future prospects in Hong Kong. We also gathered details about her son, a young, artistic boy

preferring solitude and expressing himself through drawings. However, due to space limitations and furniture constraints, he's confined to using a chair for studying and drawing. This information was meticulously organized into specific "who, where, what, when, and why" details, jotted on sticky notes. We aimed to categorize these details into two dimensions: indoor vs. outdoor activities and activities at home vs. away from home, revealing a concentration of issues within the "indoor" and "home" segments. Hence, our focus for problem-solving centers on improving indoor activities at home, addressing their primary concern.

1.6. Problem Definition

After organizing and researching Rosalie's data, we have compiled a persona, an empathy map, a journey map, and a make sense of data, respectively. At present, Rosalie's family's living space is very small, which restricts many necessary activities in daily life, such as the child's limited learning conditions, the family's limited dietary conditions, which leads to the child's low mood and introversion. Rosalie has raised two serious problems with us, one is the lack of a kitchen and the other is the poor learning conditions of her son, both of which are due to the small indoor space and the lack of space utilization. Therefore, our design direction was to improve the indoor space utilization to ensure the quality of indoor activities they can do. In addition, we also analyzed other causes of these problems, such as the smoke alarm system that limits the indoor frying and other more difficult problems. Since we were only able to improve on what we already had, and could not actually increase the size of the house or realize smoke evacuation inside the house, we ultimately decided to address the children's study space as our main goal. Using the improvement of space utilization as a starting point and vertical storage as an inspiration, we tried to design a piece of furniture that could satisfy their daily needs in a variety of ways. This furniture can utilize the vertical space of the house without taking up too much horizontal area, and achieve the goal of improving space utilization.

1.7. Ideate

To tackle indoor space constraints, we explore both horizontal and vertical solutions, focusing on enhancing furniture functionality. Our approach involves various multifunctional furniture designs, such as storage beds, foldable single beds, staircase beds, folding desks, hammock desks, flip desks, bedside telescopic desks, and creative combinations like desk-closet hybrids and door screen-table hybrids to optimize space usage. Considering our primary users—children—and their growth process, sustainability is a key factor. As children grow, their needs evolve, prompting us to create adaptable furniture that accommodates their changing heights and requirements, supporting their learning journey into adulthood. After thorough consideration of user needs and indoor structural limitations, we decided on a folding multifunctional furniture design. This versatile solution serves as a desk, cabinet, closet, and more, featuring adjustable table heights to cater to children's growth stages.

1.8. Problem Definition

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satisfy their daily needs in a variety of ways. This furniture can utilize the vertical space of the house without taking up too much horizontal area, and achieve the goal of improving space utilization.

1.9. Problem Statement

We want to design a multifunctional folding furniture, for immigrant family, especially for children, in order to add three working surfaces on furniture for children to draw and place learning related things.

2. Prototype

2.1. Project Overview

Hong Kong is a very inclusive city with nearly 9,900 refugees from all over the world. Among them, about 20% are from Pakistan and India, 15% from Vietnam, 13% from Bangladesh, and 11% from Indonesia. Most of these refugees are unable to find jobs in Hong Kong. We interviewed some of them and found that they can only live in very small spaces, which causes many inconveniences in their lives. A family of three can only squeeze into a room of a few square meters, and the adults don't have enough space to cook, and the children don't have space to study, do their homework, draw and so on, and they can only use a small board on their beds to complete these basic living activities. They can only complete these basic living activities on a small board on their beds.

Based on the actual difficulties of refugees' life, we designed a foldable multifunctional furniture inspired by the Chinese screen for them according to the specific problems they described. It takes the form of a collapsible board, which is made up of three relatively independent boards, each of which has three tables of different heights that can be flipped over for use. The lowest table can be used for young children to sit on the ground or sit on the bed, the middle layer for older children to sit on the bed or stool to do homework, the highest layer can be used for parents to store clothes, or stand up to engage in some daily activities. It can be opened to form different sizes of tables, part of which can be used as drying racks, which can not only solve the problem of inefficient use of space, but also provide a table for their children to study, and at the same time can also provide space for adults to fold clothes.

There are three pictures below about the effect of the foldable furniture we designed. Figure 1 is the overall appearance after unfolding. Figure 2 is the appearance when it is used in most cases. Figure 3 is the appearance when it is stored.



Figure 1. Overall appearance after unfolding (Source author himself)



Figure 2. Appearance when used in most cases (Source author himself)



Figure 3. Appearance when stored (Source author himself)

2.2. Design Process

The whole project can work with the Hong Kong Refugee Relief Organization. It allows us to better understand the living needs of the refugees, prioritize the problems and find ways to solve them, as well as test different experiences of different users and get first-hand information.

Based on the spatial structure provided by the refugees, we modeled the design on the ancient Chinese curved screen, whose main features are that it does not require a base, which saves space, consists of multiple connected panels, can be folded, and can be placed curved or straight, which is more flexible. The shape is dignified and atmospheric, and privacy. This not only saves space but also protects personal privacy.

For this reason, we pay great attention to prototyping, so that our ideas can be visualized, so that the refugees can understand our design faster and more intuitively, so that we can get effective feedback, and then modify our design to better serve the refugees.

We drafted a large number of sketches and cardboard models to explore a wider scope, and in the process of cardboard production, we further discovered the problems of the original design, so that we could modify it to make our design more feasible.

2.3. Interaction Design

Donald pointed out that the product has visibility, i.e., users can intuitively understand what the product can do, how it works and how to operate the product. During the design process, we collected and found different problems for different users' needs and made a model of the product with paper

shells. During the refugee interviews it was found that mothers need space to cook and children need to study. Our design can't satisfy all users, some of them can't solve the actual problems during the interviews, but for some of them, it can effectively improve their lack of living space. For those users who have little space at home, we overthrew the original design and designed a new prototype for them, turning the foldable part into a board, which can save space, we found that the stability of the multifunctional furniture is a big problem in the process of testing, due to the fact that the furniture is as high as 1.8 meters, and the production material is hard, which is dangerous for the children of the user's family, and we also made the furniture in the interaction design, so that we can make the furniture more stable for them. In the interaction design, we also adopted the traditional Chinese mortise and tenon structure in the furniture, which has the advantages of strong stability, high precision and good durability. This not only solves the problem of furniture stability, but also does not affect space utilization and aesthetics. We utilized an iterative approach to continuously improve our original design based on user experience.

3. Project Highlights and Case Comparison

Our project adopts the technology of traditional Chinese curved screen and mortise and tenon structure.

3.1. Evolution of Curved Screen and Spacing Relationship

3.1.1. Evolution of curved screen

According to the historical documents such as "Miscellaneous Records of the Western Capital" and "Salt and Iron Theory - Scattering Insufficiencies", we can understand that the production of the screen at that time was on a grand scale, with a large number of people and a wide range of handwriting. Screens in the Wei and Jin dynasties are more widely used, is used everywhere indoors and outdoors, surrounded by the bed and couch of the small curved screen is more abundant, the Wei and Jin dynasties appeared not directly for the people served by the small screen. For example, Gu Kaizhi of the Eastern Jin Dynasty made the "biographies of women" in the curved screen, such a curved screen without a base, generally three screen surface, the screen frame is connected by the knob, unfolding the side of the two sides can stand, such a form has a very good role in blocking the wind, not only for the use of people, but also used in the wind of the oil lamps. (Fu Shi, 2019)

3.1.2. Interval Relationship

Since ancient times, China has attached great importance to spatial intervals.

Ancient China's interior space spacing is not just a partition space, more is a reflection of this social relationship. Symbolizes the inferiority and superiority of the class society. At the same time, ancient China also through the space between the construction of social etiquette "order of honor and inferiority", "inside and outside of the difference", are reflected in the ancient space between the main form of space is through the screen. The modern spacing relationship is more of a reflection of the protection of private space. We utilize the ancient concept of screen spacing to design furniture that protects the user's private space, allowing them to have their own private space even in a very small environment. This is not only what modern adults need, but it is also an indispensable space for children as they grow up. It allows children to develop better independence and is better for their physical and mental health.

3.1.3. Mortise and Tenon Construction and Foldable Furniture

3.1.3.1 Mortise and Tenon

Mortise and tenon is a traditional Chinese joining method that combines the advantages of precision and environmental protection. Although it has lost its market in the younger generation, our design improves the traditional mortise and tenon design, updating and upgrading the ancient Chinese joining process to make it more in line with modern aesthetic needs. In our multifunctional foldable

furniture, the foldable planks are designed with semi-circles embedded in the planks, forming a simple mortise and tenon structure, and utilizing its high precision to improve the stability of the product.

3.1.3.2 Foldable Furniture

The furniture we designed belongs to the folding type of rigid folding furniture. Folding structure nodes connect the parts and components, folding the furniture parts and even the whole, so as to achieve the purpose of volume reduction and functional conversion. (Rujie Li, Qianwen Gu, Ziqian Yang, 2022)

Our design follows the principles of science, safety, function and aesthetics in the design of foldable furniture. We also added many innovative elements to the original foldable furniture.

(1) Functional innovation: Changed the previous disadvantages of the table closet and other individual furniture exist separately to waste space. By combining different functional furniture such as tables, clothes racks, and folding boards into one, mothers and children can complete basic life activities such as folding clothes, doing housework, and doing homework in our multi-functional furniture, which enhances their sense of well-being in life.

(2) The use of new materials: We learned during our interviews with refugees that their rooms are prone to moisture, not only refugees, but also most residents in Hong Kong. By simulating the organic process of rock formation, Kazakhstan designer Enis Akiev has developed a way to turn disposable plastic packaging into tiles: Household plastic waste is collected, sorted by color and type of plastic, then washed and dried, after which it is melted in an oven, molded by heat fusion and pressure, then cut and polished, and the floor tiles are finally formed. It is like a new type of stone that can be used in interior projects. The floor tiles fused with different colors of plastic waste are also different and have a high artistic creation value; meanwhile, reusing the waste materials not only has a beautiful appearance, but also has a quite good quality.

Portable, storage innovation: we changed the usual furniture covers a large area, storage is difficult, foldable multi-functional furniture allows refugees to store the furniture next to the wall, do not need to use the time convenient storage, unfolding is not very large, will not let the children do not have a place to walk activities.

3.2. Comparison

Nuovoliola's sofa bed is similar to ours in that it is a foldable space-saving piece of furniture. The entire bed can be flipped and hidden inside the wall when not needed. In addition to being a great space saver, the shelf on the bed naturally turns into a bed leg when it is transformed. (Rao Rupo, 2015). Compared to Nuovoliola's sofa bed, the plastic material we use is designed to be less expensive, lighter and easier to store and fold. However, at the same time our product is less sturdy and less stable compared to Nuovoliola's sofa bed, as well as having less space for storage and organizing. Combining the considerations of culture and sturdiness, we finally decided to use wood as the main material.

4. Underlying Mechanisms

Underlying mechanisms of the design are mainly in finding the pain points of the project and continuously exploring the factors that can be explored. During the interviews, we found that the common pain point of the users was that their living environment was too small, and most of the refugees cited the living environment as their main pain point. So we start from the aspect of providing a better environment for them to explore the potential factors of the project.

Consider the following three aspects:

A. Social factors

Although the product belongs to inclusive design and the main target customers are refugees, it is equally applicable to other Hong Kong people, which is mainly reflected in the following aspects:

- (1) Hong Kong's population is aging seriously, the elderly in Hong Kong have little living space and need multi-functional folding furniture to save space for them and improve their quality of life.
- (2) Hong Kong's high property prices, one of the most expensive areas in the world, many people with limited income levels live in a small space, the furniture can help them effectively utilize the space.
- (3) With the development of society, people's lifestyles have changed, and people are adopting more simple and convenient lifestyles, and multi-functional folding furniture can meet people's needs for such lifestyles.
- (4) Enhancement of environmental awareness. Hong Kong residents generally have a strong sense of environmental protection, people are concerned about the protection of resources and the environment, this furniture can reduce unnecessary waste of resources.

B. Economic factors

The cost of the program is low and the audience is extremely wide. On the one hand the project can reduce the cost of housing renovation, which can meet the living needs of different residents, as well as reduce the cost of housing renovation, and at the same time create new business opportunities. Such as the production, design and sale of furniture, bringing more potential employment and economic development opportunities to Hong Kong. On the other hand, it is reflected in the improvement of the quality of home furnishings. The product is modeled after the shape of the classical Chinese curved screen, which is highly comfortable and aesthetically pleasing, and can enhance the image and quality of the furniture industry. The project can also comply with the economic development trend, to create a more convenient life furniture for people.

C. Technical factors

Material selection technology: we will choose moisture-proof new material technology, which can provide more choices for the design and manufacture of multifunctional folding furniture, such as lightweight and high-strength materials or environmentally friendly materials to improve product quality and service life.

Modular design technology: Multi-functional materials can adopt modular design, different parts have different functions, which is convenient for users to adopt different functions according to their needs.

Style design technology: multifunctional foldable furniture style to meet the market aesthetic, and has a unique Chinese flavor, is the product of the fusion of Chinese classical furniture design and modern design, with unique characteristics, and a wider audience, technology development prospects are strong.

5. Effectiveness

The above material through prototyping and interaction design concludes that our multi-functional foldable furniture can solve the space utilization problems of many refugees and Hong Kong residents, but it cannot solve everyone's problems.

5.1. Effectiveness Analysis

- (1) Effectively improve the problem of low efficiency of space utilization and increase the efficiency of space utilization.

Multi-functional folding furniture can play a maximum role in limited space, folded up to enable users to have a place to fold clothes, children can also have a place to learn to write, reducing the waste of furniture on the occupation of space, and improve the quality of life of users.

(2) Meet the economic expectations of refugees

Multi-functional foldable furniture has a low cost and is expected to be sold at a low price, easy to maintain, easy to use, and the materials are easy to purchase. Many refugees are able to afford it, and at the same time it can reduce a lot of furniture costs for them, with the closet and desk combined into one.

(3) Adopt interaction design to understand user needs more effectively

Change the previous single design, the ancient Chinese curved screen elements into the modern design. The design process designers have communicated with users many times, and found some problems with the design, after continuous improvement, our design has been able to meet the spatial needs of the majority of people, but a small number of special cases of refugees are still difficult to meet.

(4) Effectiveness of research method

Our research method is an iterative process of using interaction design to optimize the stability and usefulness of the product. In the design process, we continue to ask questions, gradually grasp the evolutionary laws, and through a variety of thinking deduction process, after continuous iteration eventually form our final design, with reckless law opening, with iterative thinking continued.

It was time to draw on traditional Chinese screens and mortise and tenon structures to design a space-saving, multi-functional, modular furniture for refugees, but this type of furniture is somewhat restrictive, and there is no way to cover all of the refugee families. The failure of the first interaction with the refugees showed that our design was not very generalizable, but it was very effective for the second interview with the refugee, who thought that the furniture was a good solution to the problem of space utilization in their homes, and that it was a more environmentally friendly, efficient, and convenient option to reduce the cost of purchasing and replacing furniture.

Our design does not take up too much space, and can ensure that the children have space to draw and study, while at the same time meeting the needs of mothers for storing clothes and other daily activities. However, there are still some groups whose needs are difficult to meet, and the product has certain loopholes, such as the thin cross-section that makes it difficult to cook steadily on top of the table, and is prone to collapsing when the tabletop moves. Therefore, the follow-up work still needs to be adjusted in some aspects to continuously enhance the applicability.

5.2. Social Significance

With the improvement of people's living standards and taste for life, most people's demand for home furnishing products has shifted from "quantitative fulfillment" to "quality pursuit" and even "emotional communication. The demand for home furnishing products has shifted from "quantitative satisfaction" to "qualitative pursuit" and even "emotional communication". However, for the new immigrant families in Hong Kong, the most basic satisfaction is difficult to achieve. Therefore, we hope to make up for the lack of needs of this group, and hope to provide cultural characteristics on the basis of meeting their functional needs; we can also ensure that the structure and materials of the product are safe and effective, and ensure that the product is affordable.

(1) Upholding the values of sustainable development

With the progress of the times and the updating of concepts, the strategy of sustainable development is becoming more and more important for products. We take into account the different needs of children's growth on furniture in our design, so that the product is not only for a certain stage or a specific group of people, in order to realize the purpose of extending the product life cycle, increasing applicability and inclusiveness.

(2) Cultural value

Culture is an important aspect of environmental factors, in the daily living environment, the tangible physical environment and intangible cultural environment will have a subtle influence on the user. In this design, we take the traditional Chinese furniture curved screen as the source of inspiration, and the traditional Chinese connection method of mortise and tenon joinery as the technical guarantee, which implies the inclusiveness of the traditional Chinese culture. Loneliness and non-integration are common negative emotions for groups in foreign countries. Therefore, the concept of tolerance and integration is integrated into the product design concept to shorten the emotional distance with the user and realize cultural identity.

(3)Applicable to many groups

This product has the characteristics of foldable and easy to move, so it is also applicable to some people with irregular office locations, solving the problem of their office space.

6. Test

6.1. Information from Interviewees

The first interviewee ROSALIE LOREHZO (Filipino):

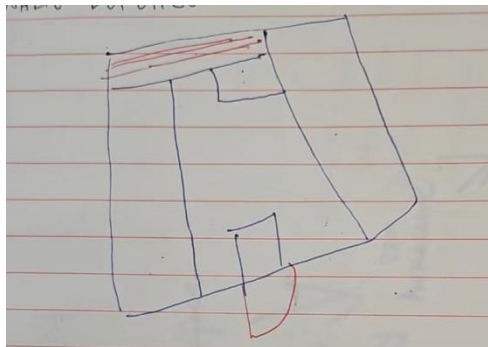


Figure 4. Product design (Source author himself)

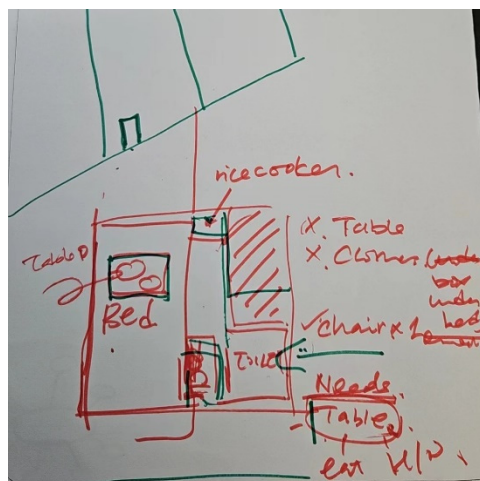


Figure 5. Schematic diagram of ROSALIE LOREHZO's room (Source author himself)

There is no space for the furniture when it is unfolded. We designed the product according to the schematic diagram that ROSALIE LOREHZO described to us in the first interview (see Figure 4). In the second interview, after seeing our product model, she told us that the corridor in their house was occupied by chairs, and it was difficult for people to pass through the corridor, and the furniture could not be unfolded in the small space. There was also not enough space around the bed for the multifunctional foldable furniture. Even when we offered to fold the furniture and put it into storage next to the bed, she still said there wasn't enough room.

Three sides of her bed are against the wall, and the kitchen is right next to the bed. Also, the door to the bathroom faces the bed, and you can not put this multi-functional furniture around the bathroom (see Figure 5). Currently, the family puts a wooden board on the bed, on which they usually study, eat, work, etc. ROSALIE claims that the board is sufficient.

No space to store the furniture after folded. The multifunctional foldable furniture we designed consists of three parts. When it is folded, it has a certain thickness, and the space under the bed of ROSALIE is occupied by three boxes, and there is no space to put the folded furniture beside the bed. We can't reduce the thickness of the product to make it easier to store. If the furniture is designed to be thinner, it will not be able to support the furniture when it is unfolded.

Insufficient stability at the furniture fixing place. We suggested that the furniture could be fixed to the wall against which the bed rests. This way her son could unfold the furniture and use it for his homework when he was doing his homework. When it is not normally used, it is folded up like a plank of wood. Then a new problem arises. As the furniture needs to be fixed to the wall, it is not secure and Rosalie is worried that if the furniture is not fixed properly, her son could be hit when he sleeps at night.

The second interviewee LISNA (Indonesian):

Furniture is prone to mold. In a small space, air does not circulate easily. Moisture vapor generated from cooking will adhere to the furniture. Moreover, Hong Kong belongs to the subtropical region and is alternately affected by colder north/northeast air currents and by warmer and more humid east/southeast air currents. The temperature drops when the cooler airflow is in effect. Once the wind shifts to the southeast, the warmer airflow passes over the cooler surfaces and the temperature drops, thus increasing the relative humidity. General furniture materials such as wood, MDF, and medium fiberboard are susceptible to mold. Among them, the medium fiberboard is most likely to absorb air moisture, and after absorbing the humid air will be prone to mold. The life span of the product is then greatly reduced.

Furniture prices are too high. The product was originally priced at HK\$500. We determined the price of this multifunctional folding furniture based on the competitive pricing method and the value-based pricing method. Competitive pricing is a method of determining the price of a good by back-calculating the saleable retail price based on the result of competition for a similar good in the market. Most of the existing folding dining tables in the market are priced at HK\$150 to HK\$4000 and most of the multi-functional desks are priced at HK\$100 - HK\$3000. The value-based pricing method sets a target price based on the consumer's perception of the product's value. This target value and price guides the product design thought and determines the size of the product. We combined the feedback given by the ladies, i.e. their satisfaction with the product and their willingness to buy, and positioned the price of the product at HK\$500 based on the competitive pricing method. But LISNA said that this price is too high and it is difficult for them to afford it.

Unclear function of the furniture. Our original design for this multi-functional folding furniture was for children's homework and other family members' meals. LISNA told us that she often did not have a place to fold her clothes, and that this chore needed to be done almost every day. So she needed a tabletop that specialized in folding clothes. She felt that the functions of our product were not clear enough and that it was not easy to differentiate between them when using it.

6.2. Improvement of Designed Products

6.2.1. Adjust the Size and Number of Components of the Product

According to ROSALIE's feedback, we found that she was in a very passive state when using this multi-functional folding furniture. Due to the limitation of space, this furniture can not be stretched out during the use. Then the existence of this furniture not only can't bring them convenience, but also increase their burden of using it. To enhance the sense of initiative and control in the use of ROSALIE's furniture, the first step was to adjust the dimensions of the product. In order to preserve

most of the wall area, we changed the original height of the product from 1.8 m to 1.1 m. ROSALIE's clothes are kept in a box under the bed, so there is no need for a part of the furniture where they can be hung. And, as the other two sections had similar functions, she didn't need as much. Therefore, we removed two boards from the original three sections and turned them into one, keeping the function of using them for homework and eating. With only one plank, the thickness is also reduced. This fulfills the need for use and doesn't prevent them from sleeping, nicely replacing the function of the original piece of wooden board.

6.2.2. Improve the Material of the Product

Not only these ladies, most of Hong Kong people are facing the problem of damp and moldy furniture. Plastic material does solve the problem of moisture resistance, but according to the feedback from ROSALIE and LISNA, they prefer to use wooden material. Different countries have different cultures and religions, and different cultures and religions have their own color symbols and color taboos. For example, LISNA's country, Indonesia, mainly believes in Hinduism, Buddhism, Islam, Christianity and Catholicism. In Buddhism, yellow is regarded as a sublime color, but in Christianity it is considered to be a vile and shameful symbol. It is difficult to choose in terms of color with plastic materials. Therefore, we use wood and return to the natural color, which can reduce the disrespect and contradiction because of the color. On top of that, we will add a layer of waterproof material on the outside of the product so that the furniture will not be affected by steam and become moldy.

6.2.3. Choosing the Device to Fix the Product

As there is only one wooden board left, the weight is also greatly reduced, making the fixing more stable and safe. Fixed furniture is based on personalization, itself and the environment integration performance integrity, better interpretation of the functionality and structure of fixed furniture. The purpose of the structural design of fixed furniture is not only aesthetic, but also combined with the user's home fixing conditions. When installing the product, use stainless steel nailless and non-marking hooks (See figure 6). Firstly, installation costs are reduced, reducing the total cost of the product. Secondly, the partition of the subdivided room is not suitable for nails, which will damage the overall structure of the house. Choosing non-marking hooks also does not affect the next occupants. Thirdly, stainless steel can resist moisture and can reduce the frequency of replacement of parts. In addition to this, you can add furniture anti-tipper (See figure 7). With double insurance, this collapsible furniture will be presented in a relatively stable form.



Figure 6. Stainless steel nailless and non-marking hooks (Source internet)

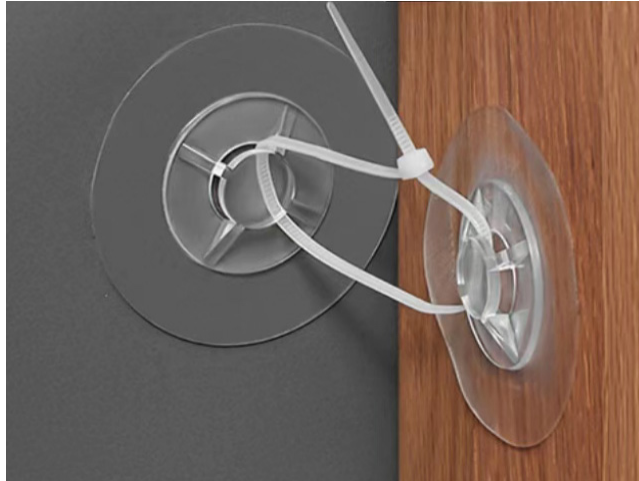


Figure 7. furniture anti-tipper (Source internet)

6.2.4. Adjust the Price of the Product

After Determining the Material Of The Furniture, we will consider the practicality of the material, the functionality of the furniture as the premise, and then go to re-evaluate this furniture, not to pursue low cost and lost the meaning of the product itself.

6.2.5. Define the Function of the Product

For the end user of the product - the consumer, their experience is the most important. Based on LISNA's description, we decided to add a clothes icon to the board to differentiate the area for folding clothes. This will distinguish the part of writing homework and the part of folding clothes from each other.

6.2.6. Adding Product Customization

Like ROSALIE, many of the tenants have very small houses. Increasing the efficiency of space utilization can improve the user's sense of well-being. Putting this multi-functional foldable furniture in different locations in the house can produce different usage effects. Everyone's needs are different, and we will explore more possibilities in our design. The first step to increase product customization is to differentiate the design for different room types. Like ROSALIE's smaller house, due to space limitations, we will keep one of their most needed features for them. And according to the specific circumstances of the furniture installed differently. Like LISNA's slightly larger home, which means that there is extra area in addition to the existing furniture, we utilize the full functionality of this furniture, including hanging, folding, doing homework, eating, etc.

We will also expand this product to be used in other places, such as library reading rooms, offices, etc., to add unlimited possibilities of use in limited space.

6.3. Experience

The research journey uncovered pivotal aspects: understanding Rosalie's environment before design, communicating effectively to align product solutions with genuine needs, and ensuring user familiarity with the designed furniture. Rosalie's initial disconnect with our design stemmed from overlooking her home's size and furniture placement. Realizing this, we engaged in comprehensive discussions, comparing her existing panels with our proposed solutions, gradually earning her acceptance. Teaching users not just the functions but also safety measures and maintenance guidelines is crucial for product effectiveness. Rigorous design thinking involves a clear, logical sequence, from problem identification to solution perfection, avoiding aimless creation. Tailoring designs to individual needs demands a deep, systematic analysis of specific issues—considering differences in room sizes and users' functional requirements. Moreover, maintaining a fresh perspective in design, merging function and beauty, challenges conventional thinking and fosters personal design concepts.

7. Conclusion

Through interviews with refugees, we designed multifunctional foldable furniture for the problem of poor space utilization efficiency of refugees. During the design process, we deduced the design concept by collecting data, applied interaction design and iterative methods to continuously update and upgrade, optimized the design structure, and then made the prototype of the product, communicated with the refugees again, and made improvements again to ultimately make our product meet the needs of more people, but it can't satisfy the needs of all people, and it still needs to be strengthened in some aspects.

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