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Usable Multifunction Chair-Desk for Ergonomic Kitchen Work

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ABSTRACT

Domestic kitchen tasks often involve prolonged standing and repetitive movements, leading to fatigue, musculoskeletal disorders, and other issues. Although modern households increasingly value comfort and efficiency, many kitchen environments have not evolved to match ergonomic needs. However, most kitchen tools remain conventional, offering limited ergonomic support. This study addresses the gap by proposing a multifunctional kitchen chair-desk that is both usable and efficient, aiming to reduce physical strain and enhance work efficiency. Using a systematic product design approach, including Design for Manufacturing and anthropometric-based industrial design, a prototype was developed through user interviews and ergonomic analysis. The results show that integrating a chair with a folding cutting board, utensil compartments, and waste disposal features significantly improves user comfort and minimizes unnecessary mobility. The final design accommodates various users through adjustable and anthropometrically appropriate dimensions, comprising a 40 cm chair width, a 26 cm first rack compartment and workstation distance, and a 46 cm second rack compartment to workstation distance. This multifunctional product has the potential to enhance kitchen ergonomics, especially for vulnerable populations in daily cooking activities. Future work may include a comprehensive cost analysis, lifecycle assessment, and long-term user testing to evaluate durability, affordability, and the real-world adoption potential of this solution in both domestic and small-scale commercial kitchens.

Keywords: Kitchen chair; usable; comfort cooking; musculoskeletal disorders

INTRODUCTION

The kitchen, as a highly utilized domestic space, frequently accommodates activities such as cutting, cooking, cleaning, and waste disposal. These tasks are often time-consuming and physically demanding (Martens & Scott 2017; Žarić et al. 2021). For the various types of kitchen users, e.g., housewives, house helpers, elderly individuals, or those with physical disabilities, these activities can lead to fatigue (Otufale & Lasisi, 2024), musculoskeletal pain (Abdelsalam et al. 2023), and a reduction in productivity and efficiency (Ismail et al. 2021). Prolonged standing postures, commonly required for kitchen tasks, are associated with various physical complaints, including pain in the feet, back, and lower back, primarily due to sustained pressure.

This issue is particularly pertinent given that many individuals, including the general population, can experience fatigue and discomfort during prolonged kitchen tasks (Yates & Brown 2025). A significant proportion of conventional kitchen designs necessitate users to stand for extended periods, particularly when preparing ingredients on separate countertops. This design paradigm underscores an urgent need for more ergonomic and efficient solutions, benefiting all users in a domestic kitchen setting.

Given these shortcomings in traditional kitchen setups, there is a clear rationale for developing interventions that directly address these ergonomic gaps. Building upon the identified ergonomic challenges, a clear opportunity emerges to design a product that enhances comfort, improves efficiency, and reduces the physical burden associated with kitchen tasks (Adiga 2023; Karwowski et al. 2025). Before developing such a solution, a thorough understanding of the specific needs of kitchen users is essential. Kitchen users frequently encounter difficulties when required to stand for extended periods while

preparing food, lifting heavy objects, or repeatedly moving between storage areas, waste receptacles, and workstations. Despite the prevalence of these challenges, most current kitchen designs remain conventional and do not adequately support user comfort or safety, particularly for vulnerable groups such as older adults, individuals with mobility limitations, or users with fatigue-related constraints. Existing solutions often involve separate, non-integrated tools or require significant home modifications, which can be costly and impractical. This gap indicates a significant unmet need for a comprehensive and usable kitchen solution. Such a solution should directly address issues like prolonged standing, repetitive movements, and the need for easy access to tools and waste disposal.

Regarding this need, the objective of this study was to propose a multifunction kitchen chair-desk to prevent the ergonomic-related problems faced by kitchen users. This study tried to fulfil the basic needs of kitchen users (e.g., comfort, safety, and cooking efficiency) by designing a user-centered multifunction chair-desk. The proposed design can contribute to the well-being of kitchen users and workers, which is in line with Sustainable Development Goal (SDG) 3 about health and well-being (Radzalia et al. 2025).

METHODOLOGY

The proposed product was developed by utilizing a systematic product design method. The process involved several strategic steps. The initial stage in the manufacturing design process for the multifunctional chair and desk involved gathering information through brainstorming sessions. These sessions primarily focused on identifying user needs, particularly in relation to the product's features and comfort. The study also utilizes a Design for Manufacturing method to create a product that has a business orientation (Cantó et al. 2021; El Wakil, 2025). This method is applicable to this case because it considers holistic factors, including material selection, production process, and assembly process. The whole process is described using Figure 4.

DESIGN FOR MANUFACTURING PROCESS

The manufacturing system flow illustrates the systematic transformation of various inputs into finished products, while also accounting for rejected items. The primary inputs feeding into this system are the workforce and raw materials. Workforce refers to the human resources responsible for executing and overseeing the production process (White, 2021), whereas raw materials represent the fundamental components that will be processed into the final product (Ferro et al. 2021). Throughout the production cycle, several supporting elements play a crucial role in maintaining operational fluidity and effectiveness. These include equipment, information, energy, and services (Dincer & Aydin, 2023). These four elements work synergistically to enhance both efficiency and product quality. The outputs of this manufacturing system are the finished products, representing the desired outcome, and rejected products, which are items that fail to meet established quality standards. This process is described in Figure 1.

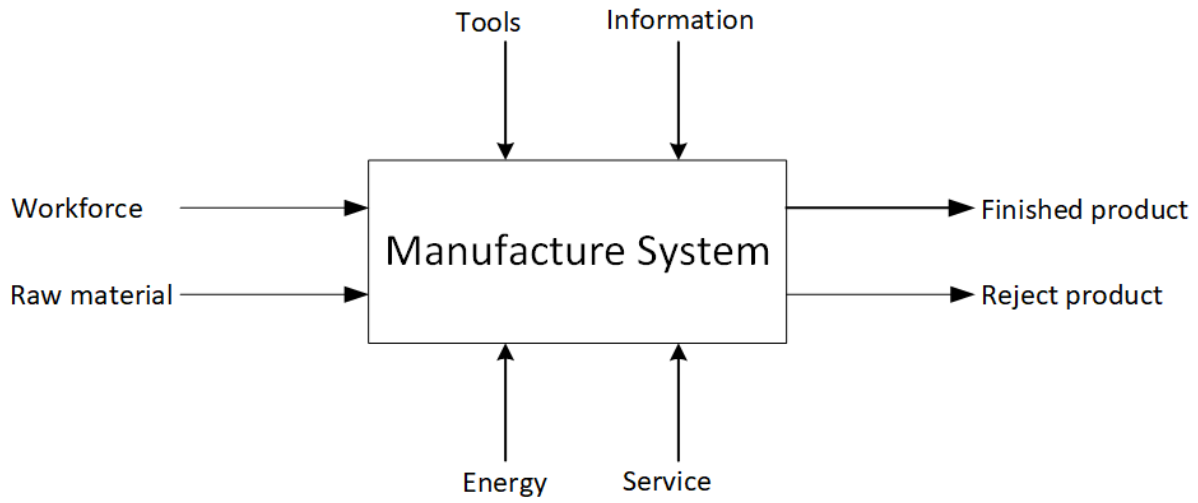


FIGURE 1. Considered aspects for the proposed product

INDUSTRIAL DESIGN

The industrial design methodology employs a systematic approach to developing products that are both functional and usable, as well as ergonomic. In the design of the tool or product, the primary focus was on enhancing user comfort to support various kitchen tasks for different user types. Consequently, ergonomics and usability were prioritized over purely aesthetic considerations such as visual appeal or colour.

The subsequent stage in the product development process involves refining and expanding the initial concept for the product. This ideation phase primarily focuses on maximizing the ergonomic benefits of the product for users. Therefore, the identified users' needs were used as the main fuel to generate the product concept and even detailed specifications (Chiu et al. 2021).

Then, the product architecture phase primarily focused on engineering the product's primary structure. The objective of this phase was to compile various kitchen functionalities into a "one-stop", practical, ergonomic, and usable appliance. This product comprises several interdependent components, all designed to endorse user comfort, safety, and efficiency during activities in the kitchen environment. This stage involved three main steps: product conceptualization, product element classification, and product analysis.

The design of the product in this study was developed using secondary anthropometric data specifically derived from the Indonesian population (Chuan et al. 2010). This anthropometric approach was applied to ensure that users can perform kitchen tasks more comfortably and with reduced fatigue (Otufale & Lasisi, 2024). The multifunctional chair-desk was designed as a portable aid for regular kitchen activities, including additional storage compartments and an integrated cutting board.

USER NEEDS IDENTIFICATION

In the realm of product development, the initial and crucial step involves the systematic identification of consumer needs (Chiu et al. 2021). This process is paramount as it facilitates subsequent product design and planning by enabling manufacturers to align the proposed product with actual consumer requirements. This phase is crucial in the design process to ensure the results are usable for the users. This identification of consumer needs is particularly vital when developing products for activities such as food preparation, which require a diverse array of kitchen equipment to support the cooking process.

In this step, 10 participants (5 female, 5 male, mean age = 21.25 ± 0.01) who regularly engaged in daily kitchen activities to cook were invited to participate in an interview regarding their needs during cooking. The criteria used for selecting participants were sex (balanced ratio), familiarity with cooking activities (at least four times a week), and the absence of any motor disabilities. The sample size has satisfied the requirement for designing the product using the design for manufacturing process (Malterud et al. 2016). The participants were recruited and did the interview voluntarily. The user's needs were identified using a front-end process approach. This step was also part of the concept generation step. The anthropometric data of the participants were also measured to determine the product part dimensions. Descriptive statistics were used to calculate the mean and standard deviation, allowing for the analysis of the data.

RESULT AND DISCUSSION

EXPECTED DESIGN FEATURES

Users long for a multifunction product that can help them do their kitchen activities comfortably and efficiently. The users expected a tool that supports their cooking activities and helps them prevent premature fatigue due to incorrect posture or working positions. The product should be able to perform at least the basic tasks during cooking in the kitchen.

Preparing food in a kitchen environment requires the use of a variety of tools to support different stages, ranging from washing and cutting ingredients to the frying process. During these culinary tasks, users frequently reported experiencing fatigue. This can be attributed to the multifaceted nature of food preparation, particularly the prolonged and standing-based activity of ingredient cutting, which often leads to significant user exhaustion (Abdelsalam et al. 2023; Otufale & Lasisi, 2024). Furthermore, existing kitchen equipment lacks integrated solutions designed to mitigate the fatigue associated with these preparatory cooking tasks. Users explicitly hope to have tools that can support them, especially during the cutting process, which is usually the leading cause of cooking exhaustion. Users long for a tool that can reduce their mobility during cooking, such as preparing the necessary tools (e.g., knife, plate, chopper) and materials.

At the same time, users have complaints related to the posture while cooking. Typically, the user performs the process standing, which causes them to become fatigued easily. Moreover, the long duration of standing in workers

leads to musculoskeletal problems (Abdelsalam et al. 2023) and even osteoarthritis (Bishop, 2024), especially for workers who have high body weight. The users then expect to have a product for sitting while cooking, which will help them save energy by correcting their working posture.

The whole task, based on the interview for the general cooking activity, especially in preparation and cleaning up parts, can be described by Figure 2. The grey-shaded area in this figure shows the main part that users mention may cause difficulties or musculoskeletal and mobility problems. Therefore, the focus of solution generation should concern these issues.

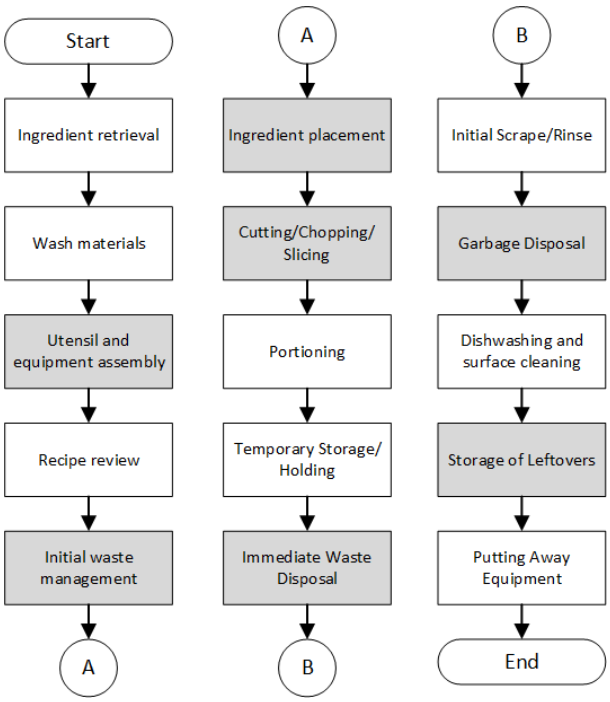


FIGURE 2. Task analysis for general cooking activities

Through brainstorming of the interview results and collaborative ideation, key user pain points emerged, highlighting the need to reduce mobility during cooking by creating a "one-stop" workstation that enables users to maintain a comfortable seated posture while cooking and integrates essential functionalities. This comprehensive understanding of user requirements led to the proposal to develop a solution that combines a chair, providing a comfortable seating option for users, with a folding tabletop that serves as a cutting board for ingredient preparation. Additionally, the design incorporates a compartment for storing kitchen utensils and an integrated waste disposal channel. Therefore, the product becomes a truly multifunctional product. This integrated design is specifically engineered to facilitate and ease the cooking process by providing better comfort and efficiency for kitchen users (Artania et al. 2025). The better postures users maintain while cooking will reduce the risk of pain (B. Li et al. 2025; Y. Li et al. 2024).

PRODUCT SPECIFICATION

The expected features were then realized by designing the specifications based on the results from the brainstorming. The specifications were determined to fulfil the users' needs and overcome their difficulties, as mentioned above. The main specification of the product consists of three main parts, comprising an ergonomic seat, an integrated tabletop for a material cutting board, a compartment, and a garbage or "scrap" disposal area. The ergonomic chair was designed to promote optimal posture and reduce physical strain during kitchen activities. Its form factor is specifically tailored to minimize pressure on the legs and back, a common issue during prolonged standing tasks in the kitchen. The usage of ergonomically designed products will support this objective by endorsing users' safety, comfort, and work efficiency.

The ergonomic chair parts were designed using anthropometric data to determine the dimensions of the chair parts. The parts designed based on anthropometric data included the seat width, seat height, drawer handle length, and the distance between the user and the compartment. The anthropometric data used to determine the dimensions of these parts were Hip Width (HW), Popliteal Height (PH), Palm Width (PW), and Arm Reach (AR), respectively. The 95th percentile rule was applied to chair width and aisle space between the user and the compartment, and an adjustable rule was applied to chair length and drawer handle length. The selection of specific percentiles in product design is crucial for ensuring comfort and functionality across a diverse range of body types. The 95th percentile covers the larger and smaller users. In accordance with that, the seat height was set at the 95th percentile to prevent the tabletop from being excessively low for taller individuals. The cutting board is built into the front of the chair, allowing users to comfortably perform cutting tasks while seated. This setup makes cooking more comfortable and helps them maintain a better posture. This confirms the findings regarding ergonomics-based product designs, which utilize anthropometric data and help reduce posture-related risks for product users (Artania et al. 2025; Zhang et al. 2022). Furthermore, the cutting board is foldable, ensuring the product maintains a compact form factor when not in use, thus optimizing storage space. The results for the anthropometry analysis are shown in Table 1.

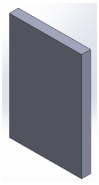
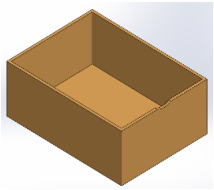
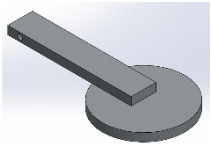
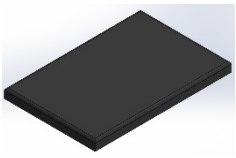
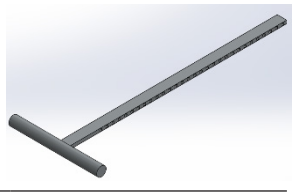
TABLE 1. Anthropometric Analysis Results for Product Dimension Determination

Part	Anthropometric data	Origin dimension (cm)	Anthropometric Measurement (cm)	Final dimension (cm)
Chair width	Hip Width (HW)	38	39.40 ± 1.12	40.00
Chair height	Popliteal Height (PH)	Adjustable	48.15 ± 2.10	Adjustable
Drawer handle length	Palm Width (PW)	Adjustable	9.35 ± 0.24	Adjustable
Distance of the compartment to the workstation	Arm Reach (AR)	23 (1st rack) 43 (2nd rack)	24.55 ± 1.50 44.45 ± 1.50	26.00 (1st rack) 46.00 (2nd rack)

An integrated waste disposal area is incorporated directly into the product. This feature is designed to significantly enhance user convenience by allowing for the immediate disposal of waste generated during food preparation, particularly after cutting tasks performed on the integrated cutting board. The design incorporates dedicated storage compartments for various kitchen utensils, including knives, spoons, forks, and other implements. This feature significantly enhances user convenience by allowing seamless access to and storage of kitchen tools without requiring the user to leave the seated position.

Besides those parts, additional supportive components are also needed to build the multifunctional chair-desk. The parts that use wood as a material include the seat base, racks, and cutting board. The parts that use metal as material include the hinge, the hinge handle, the handle lever, the cutting board end support, the main support, and the second support. The seat is also covered with a foam layer. The whole appearance and description of these parts are provided in Table 2. For a comprehensive understanding of the individual elements composing the product, a Bill of Materials (BOM) is provided in Figure 3, detailing the components of the multifunctional kitchen chair-desk. The provided BOM describes the product parts from finished products, tracing them back to the raw material level. The wood material is labelled for the base and support parts. While stainless steel becomes the material for cutting board components.

TABLE 2. Detailed Part Appearance and Description

No	Part	Figure	No.	Part	Figure
1	Base		5	Hinge	
2	Rack		6	Hinge handle	
3	Cutting Board		7	Handle lever	
4	Foam layer		8	Cutting board end support	

FINAL PRODUCT

The phases in this study culminate in a final product that is developed from the identification of consumer needs, idea generation, concept evaluation, and product testing. At the final stage, the most optimal product design is selected based on the comprehensive results from previous testing and user feedback. The final product design addresses three fundamental user needs during the preparation, utilization, and disposal of waste in the kitchen activities.

The final design also features a minimalist aesthetic with clean lines and contrasting surfaces, promoting visual clarity and ease of use. Rounded edges on the foldable table improve safety and comfort, while the visible hinges and support bars provide clear affordance cues for operation. Moreover, the colour palette used in this product features earth-tone colours. was intentionally selected to create a more natural visual, allowing users to have a restful feeling (Quiller, 2025). The color also has a huge effect on the top and middle parts, to ensure the user immediately distinguishes functional zones such as the seating area, work surface, and storage components. Collectively, these aesthetic decisions enhance usability by reducing cognitive load and reinforcing user satisfaction and market acceptance through a visually coherent and modern design language.

For food preparation, users can comfortably adjust their seating position, utilize the integrated cutting board, and dispose of waste immediately. During product utilization, users can conveniently access the storage compartments to retrieve and store cooking utensils. The final phase, waste disposal, involves users easily accessing and securing the integrated waste bin. This comprehensive design effectively consolidates cooking, storage, and sanitation functionalities into a single, practical unit. The appearance of the 3D design and its exploded view is shown in Figure 4. The 3D design shows that the upper part is covered by a layer made from foam. This part increases the users' comfort, especially for the long duration of the cooking activity in the kitchen.

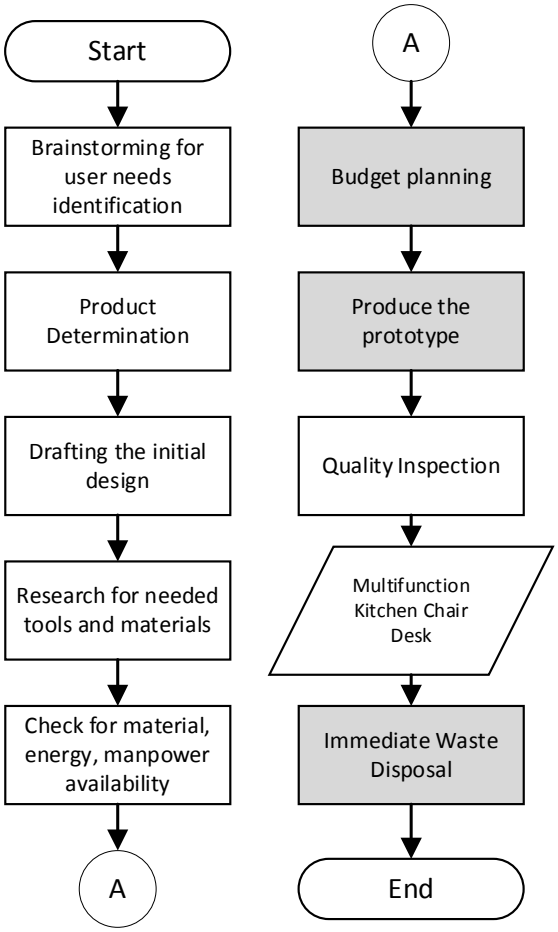


FIGURE 4. Product Design Process

The multifunction chair-desk is ergonomically designed to increase ease of use. However, user feedback is needed to improve the design. The usability of the product can be developed further by involving the feedback of the users and generating further design versions through an iterative design process (Hunt et al. 2020; Möller, 2023).

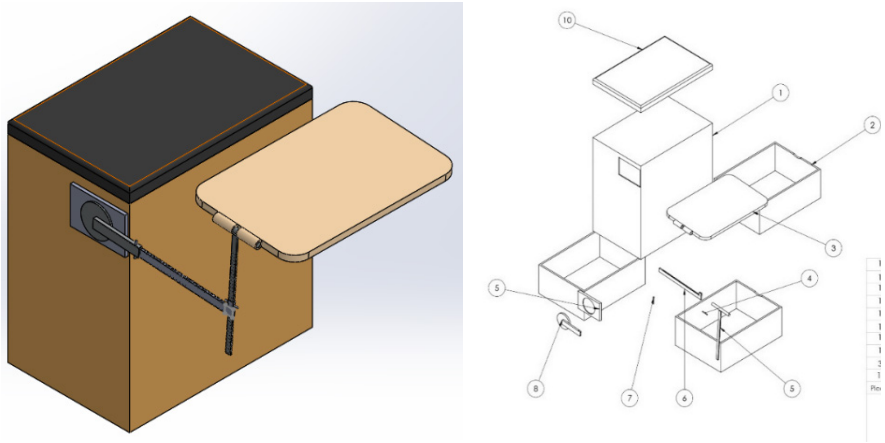


FIGURE 5. 3D design and Exploded View of the Product

CONCLUSION

The proposed multifunctional chair-desk for kitchen users was designed using a usable design process. The needs of users include a comfortable and safe cooking experience, a one-stop cooking preparation area that reduces their mobility requirements, and an ergonomically integrated cooking workstation, which can be fulfilled by this product. This integration represents the primary novelty of the study, as existing kitchen solutions typically remain fragmented and non-ergonomic, whereas the proposed design offers a unified system that supports cooking efficiency and reduces physical strain. From a scientific perspective, the study makes a significant contribution to the field by translating anthropometric and ergonomic principles into a practical design framework for domestic kitchen environments. Moreover, the product is portable, which enhances its ease of use and allows it to be adapted for various household environments, including small apartments or limited kitchen spaces. The design also emphasizes adjustability, ensuring that individuals of different body sizes can work efficiently without excessive strain. The product, however, contains a limitation of user feedback. For future direction, the iterative process can be employed to accommodate the users' feedback and involve the analysis of production costs for further development, alongside material selection, durability testing, and integration of user feedback, to ensure the product's commercial viability and long-term sustainability in both domestic and professional settings. Later, the chair-desk can be fabricated and ask the user to directly try the product for a usability test.

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DECLARATION OF COMPETING INTEREST

None.

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