User-Driven Home Office Furniture Design for Young Designers: A Kano-TRIZ Integrated Methodology

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In the post-COVID-19 era, home office has become a global norm. This study investigates the functional needs, work habits, and aesthetic preferences of young designers (21 to 35 years old) concerning home office furniture, with the goal of developing user-centered solutions. The study systematically integrated data from observations and interviews with 6 designers, 142 questionnaires, and 89 KANO surveys. Building on this foundation, the KANO-TRIZ method was applied to achieve requirement prioritization and innovative design. A functional requirement card was created, containing 42 needs (*e.g.*, desks, chairs, storage, *etc.*). Then, 23 key requirements were retained after filtering out low-priority items. Using TRIZ's 40 inventive principles, design contradictions were addressed to generate solutions. Findings reveal a preference for practical, non-overly functional products. A customizable smart workspace design, integrating modular accessories and intelligent controls, was developed, achieving an average satisfaction rating of 4.3/5. After secondary optimization (storage space: 3.7/5), the solution fully met user needs, demonstrating substantial practical value.

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INTRODUCTION

The home-office has become the norm in the post-COVID-19 era, placing higher demands on its essential component—home office furniture design. Existing studies have extensively explored the effects of such furniture on ergonomics, productivity, and mental well-being (Hill *et al*. 2003). Holzgreve *et al.* (2022) observed that non-professional temporary setups increase musculoskeletal discomfort. Davis *et al.* (2020) identified mismatched desk-chair heights and inadequate support as key issues. Under the context of crowdsourcing and generative design, exploring personalized needs is key to enhancing product feasibility (Mo *et al*. 2024). However, most studies treat users as a homogeneous group of "office workers," resulting in universal design approaches that fail to deeply analyze the diverse needs across different professions.

Against this backdrop, focusing on specific professional groups has become a key pathway to deepening research on home office furniture. There are approximately 90 million designers worldwide (Forward Industry Research Institute 2022). They heavily rely on digital tools, prefer flexible work models, psychologically seek self-expression, and exhibit a consumption tendency towards personalized products, particularly among young designers (Chen and Zhang 2023). These distinct characteristics make them have unique demands for office workers, making this group an ideal research entry point and having significant practical value.

The Kano model is highly effective for prioritizing requirements. As demonstrated by Karakurt and Cebi (2025), its application can identify critical design factors that cause customer dissatisfaction, while also revealing divergent needs across different user segments. Li *et al*. (2024) used the Kano model to identify and classify the attributes of user needs for cross-border travel document holders, thereby enhancing the user-product fit in their design. The TRIZ theory has a proven capacity to realize these needs. TRIZ is applied to the product design process to systematically guide the application of invention principles, providing a clear path for the innovation of smart furniture (Liu *et al*. 2024). The effectiveness of KANO-TRIZ has been verified in multiple studies. Chen *et al.* (2024) integrated Kano-AHP-TRIZ methodologies, combining qualitative and quantitative approaches to provide an innovative pathway for willow furniture design. Yan *et al.* (2025) through the Kano model to identify demand attributes, DEMATEL to analyze demand correlations, and TRIZ theory to resolve design conflicts, provided a scientific collaborative design strategy for dual-user products such as nail art tables and chairs.

Existing research indicates that the combination of the Kano model and TRIZ is very useful in demand analysis and innovation solution. However, when collecting requirements, most studies are not conducted in depth, which makes the subsequent analysis and the final results not necessarily feasible. Therefore, on the basis of the combination method, this study also focuses on the collection of user requirements. The research introduces the theory of mental models, combines ELAN software to achieve the transformation from subjective statements to objective behaviors, laying a data foundation for the subsequent Kano classification and TRIZ solution. Compared with technical behavioral research methods, mental models pay more attention to grasping users' psychology and can effectively obtain users' psychological needs (Atashpanjeh *et al.* 2025). Jing *et al.* (2025) proposed an age-appropriate medical terminal design strategy by constructing mental models for elderly users, effectively reducing their cognitive load.

Existing research indicates that mental models and ELAN software can accurately obtain user demands. The integration of Kano-TRIZ can classify and sort user requirements and find feasible operation solutions for corresponding functional requirements at the same time, which is in line with the design goals of this study. This study aimed to develop a home office furniture design system for young designers through systematic needs analysis and a Kano-TRIZ integration, with the objective of delivering targeted and practical design proposals.

EXPERIMENTAL

User Requirements Acquisition

Ethical statement

This research proposal has been approved by the Ethics Review Committee of Nanjing Forestry University, the approval Number is 2025026. All procedures strictly adhere to the Declaration of Helsinki and relevant Chinese laws and regulations. All the participants in this research signed a written informed consent form before the data collection process began. The consent form clearly informs about the research purpose, the data (including video recordings) will only be used for academic research, the encryption storage method of the data, the confidentiality period, and the right to withdraw from the research at any time and without conditions. To protect the privacy of the participants, all facial features and details of the environment in the recorded videos have been blurred or mosaicked to ensure the anonymity of the data analysis process.

User observation

Computer-based image recognition technology was employed to observe user behaviors. Six design practitioners aged 23 to 35 with home office experience were selected as participants. After obtaining informed consent, a complete 2 to 3 h work session in their home environment was recorded. This age range aligns with United Nations standards, China's youth development policies, and career progression traits within the design industry (Ahmad *et al.* 2001; Zhu and Shek 2020).

Table 1. Distribution Data Table for Each Level

Layer	Annotation	Annotation Count	Avg. Duration (s)	Total Annotation Time (min)	Annotation Time Percentage
Tool	Use mouse and keyboard	19	149.8	53.9	29.31%
	Using the Keyboard	4	22.6	1.26	0.68%
	Using the Mouse	40	118.4	17.6	9.56%
	Using the Palette	25	70.6	33.9	18.41%
	Use of mobile phones	19	118	42.6	23.16%
	Using an eraser	4	3.3	0.5	0.28%
Trunk Motion	Lean forward	34	73.9	48.8	26.51%
	Erect	15	23	20.7	5.55%
	Tilt back	31	101.8	61.1	33.19%
	Forward Movement	5	2.8	0.3	0.18%
	Half-lay	11	726	43.6	23.91%
	Set forth	16	31	5.3	5.06%
	Sit down	16	3.5	0.21	0.11%
Facial Expression	Yawn	5	3.9	0.23	0.13%
	Unwind	6	52.5	6.3	3.45%
	Distrust	3	16	0.96	0.52%
	Alarmed	2	1.7	0.1	0.06%
Limb	Carry on one's desk	3	11	0.66	0.36%
	Lateral access	5	32.6	7.8	4.25%
	Stationary paper	8	5	0.6	0.33%
	Rotating paper	16	49.8	15	8.13%
	Lift leg	7	366.5	44	23.91%
	Tidy up the seat	5	22.4	2.7	1.46%
	Organise your desktop	2	43	2.6	1.40%
	Clean up your desktop	2	31	1.86	1%

The recorded footage was analyzed using ELAN 6.6 multimodal analysis software. This enabled correlation analysis among torso postures, limb movements, facial expressions, and tool usage (Young 2008; Abuczki and Ghazaleh 2013). A predefined annotation framework comprising four tiers—"Tool Use," "Facial Expression," "Torso Movement," and "Limb Movement"—was applied. Behaviors were tagged according to a standardized coding scheme. The "Annotation Statistics" function in ELAN was used to compute the duration and proportion of each behavior, revealing temporal distribution patterns of actions during home office sessions (see Table 1).

User interviews

This research included in-depth interviews with six designers aged between 23 and 35 who have experience in working from home. A mental model was systematically built for users' home office scenarios by using the laddered interview method (Adapa *et al.* 2018) and Zaltman metaphor extraction technique (ZMET) (Han *et al.* 2025). Before the interview, all participants verbally confirmed their informed consent and were aware that they could withdraw from the study at any time. This research utilized the "attribute - result – value" hierarchical framework to guide the respondents to gradually delve deeper from functional attributes to psychological needs, thereby constructing a complete cognitive chain. By adopting the improved ZMET method, in the entire process recording, not only the final image selection results, were collected, but also the decision-making details such as hesitation and trade-offs during the sorting process were recorded in detail. Moreover, through real-time inquiries, the cognitive dynamics that are easily overlooked by traditional methods were supplemented.

This article takes the interview summary of the office chair of respondent No. 1 (Table 2) as an example, and Fig. 1 shows a picture of the chair chosen by the respondent. The research first extracts the key words from the description and then constructs the "attribute → result → value" conceptual chain through a ladder-like questioning method.

Fig. 1. Chair selected by participant 1

The interview records were sorted and analyzed, the extracted concepts were classified and connected, and a preliminary mental model of the interviewees was constructed. To ensure the objectivity of the model, the research team first conducted a discussion on the initial model. Then the model was presented to the respondents and confirmed. It would be adjusted according to the feedback of respondents if the model had any inconsistency. Finally, all individual models were sorted out and summarized to form the mental model of the young designers' home office, as shown in Fig. 2.

Table 2. Participant 1 interview (excerpt)

Task	Choose a chair for your ideal environment.
Respondent's statement	This product's appearance is very appealing to me. The design is very simple and the lines are very nice. Additionally, its backrest is quite high, which should provide good support for my back and neck. At the same time, it uses a mesh surface, which has better ventilation. I don't like those thick cushioned seats because they can make me sweat a lot in summer and its fabric looks very heavy.
Keyword extraction	Simple design, nice lines, high backrest, mesh surface with better ventilation, heavy fabric.
Interview Summary	Q：The simple design and elegant lines of the seat seem to be very important to you. Why is that? A：The simple design will enable me to focus more on my work. The lines remind me of the curves of the human body, making me feel very comfortable while using it. Sitting on such a nice and comfortable chair every day, my mood will also be great. Q：Do you like the feeling where your entire back and neck are supported? Why? A：Sometimes when I'm staring at the computer for a long time, my back and neck will feel sore. At such times, I hope the backrest can provide me with support, so that my neck won't be so tired. Just like the chair in the picture, this kind of support makes me feel quite good. I think this curve should also be beneficial for the health of my cervical spine. Q：Is the breathability of the seat important to you? Why? A：Personally, I don’t tend to sweat easily, but I also don’t like the warm sensation in my buttocks and back. This feeling makes me very annoyed and prevents me from working properly.
Concept extraction	Simple design → Psychological comfort → Sense of joy Proper support for the back and neck → Relieves fatigue → Enhances comfort Seat ventilation → Body comfort → Sense of joy

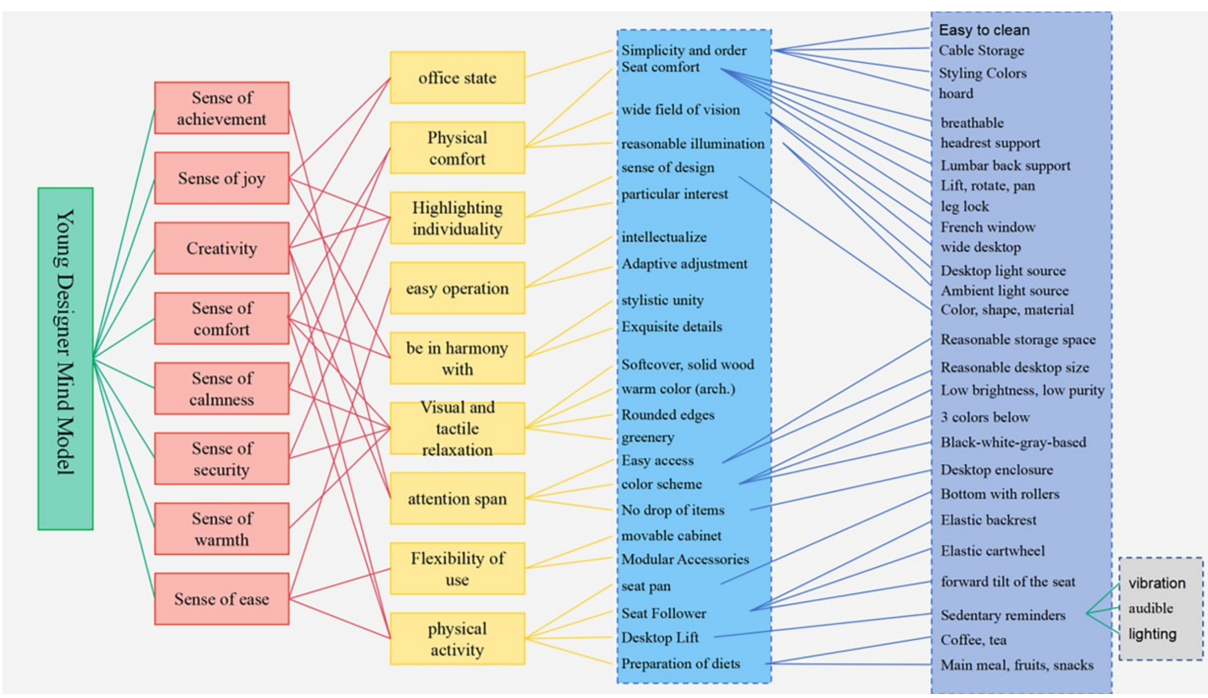

Fig. 2. A mental model for young designers working from home

Questionnaire survey

A questionnaire was developed based on insights from observations and interviews to investigate users' subjective experiences, functional needs, and aesthetic preferences regarding homework. It covered user profiles, work habits, and furniture usage preferences.

Of the 200 questionnaires distributed online, 142 valid responses were collected. The results quantitatively supplemented earlier qualitative findings. Ultimately, 42 functional demand items were identified and compiled into a demand card for young designers (see Fig. 3).

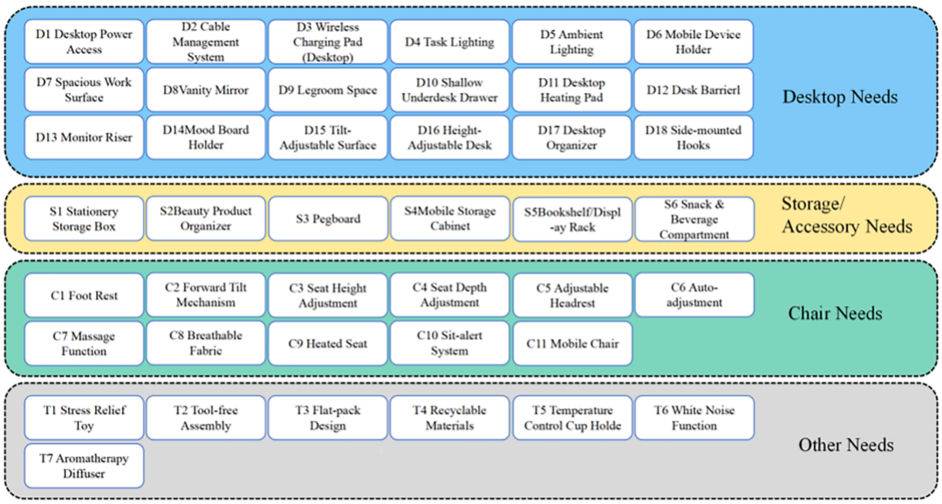

Fig. 3. Youth designer group home office function demand card

User Requirements Transformation Based on Kano Modeling

The Kano model was employed to effectively prioritize user requirements. It classifies demand attributes into five types—Must-be Quality (M), One-dimensional Quality (O), Attractive Quality (A), Indifferent Quality (I), and Reverse Quality (R)—based on the correlation between the degree of functional implementation and user satisfaction (Nielsen 1990).

Constructing a KANO model

Because it is impractical to incorporate every user-desired function into a single product, functional demand items identified from earlier user research were screened using the Kano model and a five-point Likert scale. Participants were asked to evaluate each function under two conditions: when the function "is provided" and when it "is not provided," selecting the option that best reflected their perception (Table 3).

Table 3. KANO Questionnaire Option Mode

Questions		Favorite	Necessary	Indifferent	Reluctant	Disgusting
Positive questions	Having a certain design element or function	○	○	○	○	○
Negative questions	Not having a certain design element or function	○	○	○	○	○

The Kano questionnaire was distributed to young designers, artistic creative practitioners aged 23 to 35 years old, and individuals interested in home office setups. Electronic questionnaires were disseminated *via* Questionnaire Star, WeChat Moments, WeChat groups, and QQ groups. Out of 100 distributed questionnaires, 89 valid responses were retained after excluding those that were overly long, too short, or incomplete. User responses were categorized according to the KANO evaluation table. The collected data were classified into the five demand attributes (M, O, A, I, R) using the KANO quality attribute classification table (Table 4).

Table 4. Quality Feature Classification Table

Functional Question		Reverse Problem				
		Like	Expect	Neutral	Tolerate	Dislike
Forward problem	Like	Q	A	A	A	O
	Expect	R	I	I	I	M
	Neutral	R	I	I	I	M
	Tolerate	R	I	I	I	M
	Dislike	R	R	R	R	Q
Note: Q is a questionable result that does not fit the classification of quality characteristics						

Prioritization ranking

To compare the priority levels of different design elements, further calculation of "Better-Worse" coefficients is required based on the data (Chen and Chuang 2008):

$$\text{Better (SI)} = (\text{A} + \text{O})/(\text{A} + \text{O} + \text{M} + \text{I}) \tag{1}$$

$$\text{Worse (DSI)} = (-1)^{*}(\text{O} + \text{M})/(\text{A} + \text{O} + \text{M} + \text{I}) \tag{2}$$

Through quadrant analysis of these coefficients, functional requirements were categorized. Must-be, One-dimensional, and Attractive demands were prioritized in design, while Indifferent demands were addressed selectively. The priority order was: Must-be > One-dimensional > Attractive > Indifferent. Frequency statistics of KANO options and the corresponding Better-Worse coefficients are presented in Table 5.

Table 5. Analysis of Kano and Better Worse Coefficient Results

Number	Functional Requirements	M	O	A	I	R	Category	Better	Worse
D1	Desktop Power Access	37	28	11	13	0	M	0.4382	-0.7303
D2	Cable Management System	19	38	21	11	0	O	0.6629	-0.6404
D3	Wireless Charging Pad (Desktop)	2	20	47	14	6	I	0.8072	-0.2651
D4	Task Lighting	33	25	16	15	0	M	0.4607	-0.6517
D5	Ambient Lighting	3	13	49	20	4	A	0.7294	-0.1882
D6	Mobile Device Holder	6	8	21	48	6	I	0.3494	-0.1687
D7	Spacious Work Surface	20	53	7	9	0	O	0.6742	-0.8202
D8	Vanity Mirror	9	18	10	44	8	I	0.3457	-0.3333
D9	Legroom Space	13	69	5	2	0	O	0.8315	-0.9213
D10	Shallow Underdesk Drawer	11	19	11	46	2	I	0.3448	-0.3448
D11	Desktop Heating Pad	5	11	54	12	7	A	0.7927	-0.1951

Number	Functional Requirements	M	O	A	I	R	Category	Better	Worse
D12	Desk barrier	17	42	13	10	7	O	0.6707	-0.7195
D13	Monitor Riser	4	6	33	43	3	I	0.4535	-0.1163
D14	Mood Board Holder	11	9	35	34	0	A	0.4944	-0.2247
D15	Tilt-Adjustable Surface	6	9	20	49	5	I	0.2588	-0.1163
D16	Height-Adjustable Desk	21	8	21	38	1	I	0.3295	-0.3295
D17	Desktop Organizer	0	32	25	32	0	O	0.6404	-0.3596
D18	Side-mounted Hooks	0	13	36	39	1	I	0.5568	-0.1477
S1	Stationery Storage Box	12	6	49	22	0	A	0.6180	-0.2022
S2	Beauty Product Organizer	6	9	18	56	0	I	0.3034	-0.1685
S3	Pegboard	2	2	48	37	0	A	0.5618	-0.0449
S4	Mobile Storage Cabinet	9	19	34	25	2	I	0.6092	-0.3218
S5	Bookshelf/Display Rack	5	8	17	53	6	I	0.3012	-0.1566
S6	Snack and Beverage Compartment	3	3	29	48	6	I	0.3855	-0.0723
C1	Foot Rest	2	5	37	43	2	I	0.4828	-0.0805
C2	Forward Tilt Mechanism	8	17	37	26	1	A	0.6136	-0.2841
C3	Seat Height Adjustment	19	35	16	12	7	O	0.6220	-0.6585
C4	Seat Depth Adjustment	8	6	27	45	3	I	0.3837	-0.1628
C5	Adjustable Headrest	3	4	23	55	4	I	0.3176	-0.0824
C6	Auto-adjustment	3	9	54	23	0	A	0.7079	-0.1348
C7	Massage Function	0	0	27	50	12	I	0.3506	0.0000
C8	Breathable Fabric	0	12	38	39	0	I	0.5618	-0.1348
C9	Heated Seat	2	0	37	38	12	I	0.4805	-0.0260
C10	Sit-alert System	2	9	48	30	0	A	0.6404	-0.1236
C11	Mobile Chair	10	39	11	27	2	O	0.5747	-0.5632
T1	Stress Relief Toy	0	4	54	29	2	A	0.6667	-0.0460
T2	Tool-free Assembly	13	22	24	30	0	I	0.5169	-0.3933
T3	Flat-pack Design	12	10	18	49	0	I	0.3146	-0.2472
T4	Recyclable Materials	9	17	9	54	0	I	0.2921	-0.2921
T5	Temperature Control Cup Holder	2	7	33	45	2	I	0.4598	-0.1034
T6	White Noise Function	2	1	13	54	19	I	0.2000	-0.0429
T7	Aromatherapy Diffuser	3	0	11	68	7	I	0.1341	-0.0366

Figure 4 shows the quadrant diagram based on Better-Worse analysis. Among the 42 design elements, 2 were classified as Must-be, 6 as One-dimensional, 14 as Attractive, and 20 as Indifferent. This reflects the professional characteristics of the young designer group: the two Must-be are desktop electricity and lighting, which demonstrates the feature of young designers relying on digital tools and working for long hours. The seven One-dimensional correspond to the efficiency pursuit under its high-intensity working mode. The nine Attractive are mainly in line with their consumption tendency of pursuing personalization and self-pleasure.

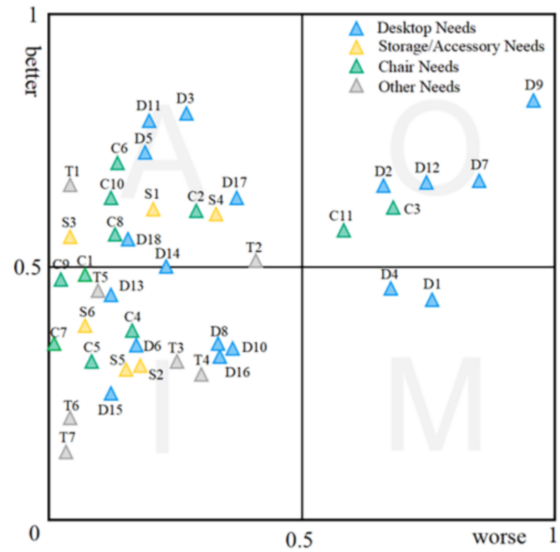

Fig. 4. Quadrant diagram of Better-Worse coefficient analysis

Table 6. Priority Sorting of Functional Requirements for Home Office Furniture

Importance Sorting	Number	Functional Requirements	Category
1	D1	Desktop Power Access	M
2	D4	Task Lighting	M
3	D9	Legroom Space	O
4	D7	Spacious Work Surface	O
5	D12	Desk Barrier	O
6	D2	Cable Management System	O
7	C3	Seat Height Adjustment	O
8	C11	Mobile Chair	O
9	D17	Desktop Organizer	O
10	D11	Desktop Heating Pad	A
11	D5	Ambient Lighting	A
12	C2	Forward Tilt Mechanism	A
13	C6	Auto-adjustment	A
14	S1	Stationery Storage Box	A
15	C10	Sit-alert System	A
16	D14	Mood Board Holder	A
17	T1	Stress Relief Toy	A
18	S3	Pegboard	A
19	D3	Wireless Charging Pad (Desktop)	I
20	S4	Mobile Storage Cabinet	I
21	T2	Tool-free Assembly	I
22	D16	Height-Adjustable Desk	I
23	C8	Breathable Fabric	I

When determining the final needs, these were ranked based on their functional strength (|Better| + |Worse|). Also, account was taken regarding the category attributes of KANO's needs. The next step was to prioritize the addition of M, O, and A demands, and then select the top-ranked I category demands that align with the trend of working from home. For instance, although the Height-Adjustable Desk (D16) was classified as I, it may be regarded as an important feature in the context of the trend of standing at work. Ultimately, 23 key requirements were retained (Table 6).

Contradiction Deconstruction Based on TRIZ

Altshuller (1988) developed the Theory of Inventive Problem Solving (TRIZ) through the analysis of numerous invention patents. The theory has significant advantages in breaking the stereotype of thinking and stimulating innovative ideas (Löfgren and Witell 2008). According to the 23 core needs, the following 6 pairs of core contradictions need to be solved are summarized.

The contradiction between the demand for a wide countertop and space occupation. Young designers need a spacious countertop to place equipment and drawing tools when working. However, in a home space, increasing the size of the tabletop will inevitably lead to an increase in the volume of furniture, causing space congestion and creating a technical contradiction.

The contradiction between the space for leg movement and structural stability. To ensure the comfort of work, designers need sufficient legroom, which usually requires the removal of lateral supports between table legs. However, this would weaken the structural stability of the furniture, possibly causing the desktop to shake and creating a technical contradiction.

The contradiction between the completeness of desktop functions and visual aesthetics. Enhancing desktop functionality (*e.g.*, with integrated power and lighting) typically compromises visual aesthetics and create a technical contradiction.

The contradiction between storage capacity and the volume of furniture. The designer needs to store a large amount of stationery, tools and materials, and requires the furniture to have a strong storage capacity. However, increasing storage space usually makes the furniture too large in volume, which is contrary to the demand for a simple home environment and creates a technical contradiction.

The contradiction between the accessibility of the cable management device and the tidiness of the desktop. The cable interface needs to be easy to plug and unplug, but it also needs to be hidden to keep the desktop neat and beautiful. This puts forward mutually exclusive requirements for the "visibility of the cable interface", creating a physical contradiction.

The contradiction in the physical property requirements of the seat surface. To provide comfort in a static sitting position, the seat surface needs to be soft. However, to provide effective support when getting up or adjusting posture, the seat surface needs to be firm, which puts forward opposite requirements for the "physical properties of the seat surface", forming a physical contradiction.

Solution to the contradiction based on the principle of invention

In desk design, the Segmentation Principle (No. 1) and Multi-layer Structure (No. 4) were used to resolve spatial conflicts: separate power circuits (strong and weak current) were designed to meet device compatibility requirements (D1), while horizontal supports were replaced with nested vertical frames to enhance legroom (D9). The Consolidation

Principle (No. 5) and Partial Discarding (No. 34) facilitated a combinatory expandable structure for the large desktop (D7) and a quick-detach anti-roll mechanism for the front guardrail (D12).

Table 7. Contradiction Analysis and Solving Principles

NO.	Requirement Number	Type of Contradiction	Improved Parameter	Worsened Parameter	Inventive Principles
1	Spacious Work Surface (D7)	Technical Contradiction	#5 Area of stationary object	#7 Volume of moving object	5, 34
2	Legroom Space (D9)		#33 Convenience of use	#13 Stability of the object's composition	2, 4
3	Desktop functional completeness (D1, D3, D4, D14, D2)		#33 Convenience of use	#32 Aesthetic appearance	1, 7
4	Storage capacity (S1, S3, D14)		#8 Volume of stationary object	#7 Volume of moving object	15, 17
5	Cable Management (D2)	Physical Contradiction	Separation in Space, Separation in Condition		24, 28
6	Physical property requirements of the seat surface (C2, C6)		Separation in Time, Separation in Condition		3, 33

Based on the identified technical and physical contradictions, the following solutions were developed in this study: The conflict between the need for a spacious tabletop and its spatial footprint was resolved by applying the Combination principle (No. 5) and the Discarding and Recovering principle (No. 34). This was specifically implemented through integrating the desktop with other office furniture to extend functional space, while eliminating redundant structures and components to enhance the sense of spaciousness and tidiness. The conflict between legroom and structural stability was resolved using the Extraction principle (No. 2) and Layered Structure principle (No. 4), removing horizontal supports to reduce obstruction while incorporating nested high-strength structures for enhanced vertical stability.

The conflict between desktop functionality and aesthetics was resolved using the Segmentation principle (No. 1) and Combination principle (No. 5). This was achieved by incorporating a recessed cable channel to maintain a clean surface, complemented by a multi-axis adjustable task light. The contradiction between storage capacity and furniture volume was addressed through the Segmentation principle (No. 1) and Prior Action principle (No. 9), achieved by dividing storage into zones and placing frequently used items in optimally accessible locations for efficient space utilization.

The physical contradiction between cable management accessibility and desktop tidiness was resolved using the Segmentation principle (No. 1) and Combination principle (No. 5), by separating the power strip into an independent, flip-up module. The contradiction in the physical properties of the seat surface was addressed by applying the Local Quality principle (No. 3) and Flexibility principle (No. 33), adding flexible materials to specific areas to better fit the forward-leaning posture while using breathable mesh to improve ventilation.

For other functional requirements not elaborated here, such as the desktop can be raised and lowered (D13), which is achieved through the nesting principle (NO.7), and the sedentary reminder (C4) is monitored and fed back through the local qualitative change principle (NO.3) and the mechanical vibration principle (NO.18). The Emotion Board Fixation (D8) achieves diverse fixation methods through the principle of division (NO.1) and the principle of alternative materials (NO.14), and these schemes together form a complete innovative design system.

RESULTS AND DISCUSSION

When formulating specific design plans, the priority of requirements systematically guides the design strategies and directions: basic type (M) and expected type (O) requirements, as the core of the design, achieve a highly integrated and unified solution. The charming type (A) and the undifferentiated type (I) requirements are flexibly realized in the plan according to their attributes. For instance, “Seat ventilation (C8, I)” is integrated into the main body, while "ambient lighting (D5, A)" and others are optional accessories. Thus, while ensuring the core, it provides users with personalized flexibility. The specific design plan is as follows

Fig. 5. Furniture combination effect

Figure 5 presents the preliminary product design proposal. The home office furniture system comprises a height-adjustable desk, an ergonomic chair, a mobile storage cabinet, and modular accessories—including task lighting, a front panel, a pegboard, and ambient LED strips—all configurable to meet user needs.

The core of the system is an electric height-adjustable desk with an ash wood desktop, providing both warmth in tactile quality and structural stability. It is available in five size options (Width: 1200 to 2000 mm × Depth: 600 to 900 mm) to suit varying spatial and functional requirements (Ding 2006).

Key functional improvements address two core demands: “desktop power access” and “task lighting.” Embedded cable channels and a flip-up hidden power strip maintain a tidy workspace, while a multi-axis adjustable lamp optimizes space utilization. To promote healthy working postures, the desk incorporates electric lifting columns. This enables height adjustment from 700 to 1200 mm, supporting both sitting and standing operations (Karol and Robertson 2015). An integrated smart sensing system monitors sitting posture and usage duration. A touch-sensitive controller centralizes the management of desk height, lighting, heating, and health reminders. A built-in desktop heating layer enhances comfort during colder months. Refer to Fig. 5 for a functional illustration of the desk.

The chair emphasizes adaptive functionality through elastic ABS material and a self-adjusting spring mechanism. It automatically tilts forward, backward, and laterally according to the user's weight and posture, eliminating manual adjustments and improving comfort and usability. Equipped with casters for mobility, the chair also offers an optional headrest and armrests adjustable from 160 to 250 mm in height, effectively reducing upper-body pressure and enhancing operational precision (Luo S. 2013).

Design scheme evaluation and improvement

To verify the rationality of the design practice, the research team evaluated the design results. A 10-person evaluation team was formed. The academic and professional relationship network of the research team was drawn upon to specifically invite 7 young designers with home office experience. At the same time, three experts specializing in furniture engineering, ergonomics and design evaluation methods (all with associate senior professional titles or above or doctoral degrees) were invited.

The System Usability Scale (Ependi *et al.* 2019) and a five-point Likert scale (Joshi *et al.* 2015) were used to assess usability and user satisfaction, respectively. The mean values of the scoring results are shown in Tables 8 and 9.

Table 8. Usability Evaluation Scale for Home Office Furniture Combination

No.	Question	Average Score	SUS Score	Rating
1	I think I would be willing to use this furniture set on a regular basis.	4.7	94	A+
2	I think the furniture design is simple and not bulky.	4.0	80	A-
3	I think the furniture is really easy to live with.	4.2	84	A
4	I believe this set of furniture will meet most of my requirements.	4.3	86	A+
5	I found that this furniture set has effectively integrated different functions.	4.2	84	A
6	I think the functional instructions for this furniture set are clear and concise.	4.0	80	A-
7	I think most people can learn what to do with this furniture.	3.9	78	B+
8	I think this furniture set is stable and reliable.	4.1	82	A
9	I didn't need to do any additional homework before I used this furniture set.	3.8	76	B

Table 9. User Satisfaction Evaluation Scale for Home Office Furniture Combination

Project	Question	Average Score	SUS Score	Rating
Appearance	The style is what I like	4.6	92	A+
	The colour scheme is what I like	4.2	84	A
	The material and texture is what I like	4.5	90	A+
	The styling is what I like, it's more versatile	4.4	88	A+
Function	Satisfied with the storage function	3.7	74	B-
	Perfect office function	4.3	86	A+
	Highly flexible	4.4	88	A+
	The introduction of intelligent features is reasonable.	4.1	82	A
	This furniture makes my office efficient.	4.1	82	A
Applicability	Size fits my home	4.3	86	A+
	Meets my individual needs	3.8	76	B

The evaluation revealed that while the current storage solution—consisting of a pegboard and mobile cabinet—adequately accommodates small items, it is insufficient for larger objects, such as packaging boxes, commonly found in home environments. To address this, a fixed storage cabinet option was introduced.

As shown in Fig. 6, the fixed cabinets—with dimensions of 1800 × 40 × 420 mm^3 and 1800 × 90 × 420 mm^3—feature open shelving at the top and storage drawers below, substantially enhancing storage capacity for home office applications.

Fig. 6. Fixed storage cabinets

DISCUSSION

This study employed a Kano-TRIZ integrated design framework for home office furniture for young designers. Previous studies have mostly focused on the integration with general ergonomics and intelligent technologies, striving to enhance users' efficiency in working from home (Fan 2019; Wütschert *et al.* 2022). The common point of this research lies in that it was also based on ergonomics and integrates intelligent technology in practice. However, the innovation of this study was mainly reflected in two aspects:

In terms of the depth of demand analysis, this study combined ELAN software, ladder interviews, and ZMET technology to establish a mental model map of young designers, ensuring the authenticity of data and the feasibility of design from the source, and providing a more solid theoretical foundation for subsequent analysis.

In terms of scheme generation, this study transformed the high-priority requirements identified by the Kano model into technical and physical contradictions in TRIZ, and systematically solved them by means of the contradiction matrix and invention principles, thus forming a traceable and systematic innovation path from requirements to schemes. For instance, in response to the contradiction between a wide countertop and space occupation, a functional integration and minimalist support solution is proposed by applying the principles of "combination" and "discard and regenerate". For the desktop lighting requirements, a quick-release lighting device that can be hidden is designed through the nesting principle.

Research limitations and future work

This study also had certain limitations. The sample ages (23 to 35 years old) and regions (mainly cities such as Nanjing and Beijing) were relatively concentrated. Although this is conducive to a deeper understanding of the target group, the universality of the conclusion needs to be further verified. In the future, the sample range can be expanded to test the cross-population applicability of the framework. In addition, physical prototypes will be produced and long-term usability tests will be conducted in the future to obtain more realistic behavioral data and enhance design efficiency and personalization levels.

CONCLUSIONS

This study successfully constructed and implemented a user-centered systematic design method for home office furniture. The main conclusions can be summarized into the following three levels:

1. Effectiveness was confirmed for the Kano-TRIZ integrated framework in furniture design innovation. This framework ensures the depth of requirement acquisition through multimodal user research (integrating observation, mental model interviews and questionnaires), uses the KANO model to achieve scientific decision-making on requirement priorities, and ultimately transforms key requirements into solvable design contradictions through the TRIZ theory, generating innovative solutions, thus forming a rigorous design logic chain of "requirement - contradiction - principle – solution".
2. A home office furniture system was developed, which included an electric height-adjustable desk, adaptive seats, and storage cabinets. Its innovation lies in the creative resolution of multiple core contradictions. For instance, it resolves the contradiction

between convenient power access and a tidy desktop through a flip-type power board. The contradiction between functional integration and space occupation is resolved through the zoned storage on the top of the mobile storage cabinet. The self-adjusting seat mechanism meets the dual demands of dynamic support and easy operation.

3. The final solution not only meets the rigid demands of young designers for basic functions and work efficiency, but it also responds to the group's deep-seated value pursuit of "self-pleasure" experience and personalized expression through modular accessories (such as ambient lights and pegboards) and intelligent emotional interaction (such as sedentary reminders and desktop heating). This research provides a full-process reference from theory to practice for product development targeting specific occupational groups, and it has strong academic value and industrial application potential.

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REFERENCES CITED

Abuczki, Á., and Ghazaleh, E. B. (2013). "An overview of multimodal corpora, annotation tools and schemes," *Argumentum* 9(1), 86-98.

Adapa, A., Nah, F. H., Hall, R. H., Siau, K., and Smith, S. N. (2018). "Factors influencing the adoption of smart wearable devices," *International Journal of Human-Computer Interaction* 34(5), 399-409. https://doi.org/10.1080/10447318.2017.1357902

Ahmad, O. B., Boschi-Pinto, C., Lopez, A. D., Murray, C. J., Lozano, R., and Inoue, M. (2001). "Age standardization of rates: A new WHO standard," *Geneva: World Health Organization* 9(10), 1-14.

Altshuller, G. S. (1988). *The theory of the Solution of Inventive Problems*, Gordon and Breach Science Publishers, New York, NY, USA.

Atashpanjeh, H., Paudel, R., and Al-Ameen, M. N. (2025). "Mental model-based designs: The study in privacy policy landscape," *International Journal of Human-Computer Interaction* 41(12), 7253-7272. https://doi.org/10.1080/10447318.2024.2392064

Chen, C. C., and Chuang, M.-C. (2008). "Integrating the Kano model into a robust design approach to enhance customer satisfaction with product design," *International Journal of Production Economics* 114(2), 667-681. https://doi.org/10.1016/j.ijpe.2008.02.015

Chen, W., and Zhang, F. (2023). "Research on functional design of office furniture for young people in E-commerce era," *Furniture & Interior Design* 30(04), 30-35. https://doi.org/10.16771/j.cn43-1247/ts.2023.04.006

Chen, Y. M., Liu, M. B., Xu, J. Y., Yu, S., and Chen, L. P. (2024). "Research on willow furniture design based on Kano-AHP and TRIZ," *BioResources* 19(4), 7723-7736. https://doi.org/10.15376/biores.19.4.7723-7736

Davis, K. G., Kotowski, S. E., Daniel, D., Gerding, T., Naylor, J., and Syck, M. (2020). "The home office: Ergonomic lessons from the 'new normal'," *Ergonomics in Design* 28(4), 4-10. https://doi.org/10.1177/1064804620937907

Ding, Y. (2006). *Ergonomics*, Beijing Institute of Technology Press, Beijing, China.

Ependi, U., Kurniawan, T. B., and Panjaitan, F. (2019). "System usability scale *vs* heuristic evaluation: A review," *Jurnal Simetris* 10(1), 65-74.

Fan, S. (2019). *Study on Smart Office Furniture Design Based on User Experience*, Master's Thesis, Zhejiang Agriculture and Forestry University, Zhejiang Province, Hangzhou, China.

Forward Industry Research Institute (2022). *China Design Industry Panorama Report 2022*, Forward Industry Research Institute, Shenzhen, China.

Han, Y., Ouyang, W., Du, H., Qiao, Z., and Wei, D. (2025). "Designing wooden lounge chairs using ZMET: From deep need discovery to value hierarchy construction," *BioResources* 20(3), 7405-7420. https://doi.org/10.15376/biores.20.3.7405-7420

Hill, E. J., Ferris, M., and Märtinson, V. (2003). "Does it matter where you work? A comparison of how three work venues (traditional office, virtual office, and home office) influence aspects of work and personal/family life," *Journal of Vocational Behavior* 63(2), 220-241. https://doi.org/10.1016/S0001-8791(03)00042-3

Jing, Y., Cheng, Y., Yu, S., and Yu, S. (2025). "Elderly healthcare support services in hospitals: Designing a medical terminal and its adaptive user interface based on the geriatric mental model," *International Journal of Human–Computer Interaction* 41(12), 7253-7272. https://doi.org/10.1080/10447318.2025.2495114

Karakurt, N. F., and Cebi, S. (2025). "A fuzzy Kano model proposal for sustainable product design: Mobile application feature analysis," *Appl. Soft Comput*. 172, article 112824. https://doi.org/10.1016/j.asoc.2025.112824

Li, S., Zhang, X., Wen, K., and Jiang, J. (2024). "Research driven by user demand for the design of a cross-border travel credential bag," *Sustainability* 16(21), article 9547. https://doi.org/10.3390/su16219547

Liu, C. C., Chen, D. F., Huang, W. L., and Liang, C. K., (2024). "Development and application of a smart mattress and integrated health management system for real-time monitoring utilizing theory of inventive problem solving and signal processing techniques," *Sensors Materials* 36(11, Part 4). https://doi.org/10.18494/SAM5342

Mo, Z., Gong, L., Gao, J., Cui, H., and Lan, J. (2024). "A knowledge graph-based implicit requirement mining method in personalized product development," *Appl. Sci.* 14(17), article 7550. https://doi.org/10.3390/app14177550

Joshi, A., Kale, S., Chandel, S., and Pal, D. K. (2015). "Likert scale: Explored and explained," *British Journal of Applied Science & Technology* 7(4), 396-403. https://doi.org/10.9734/BJAST/2015/14975

Karol, S., and Robertson, M. M. (2015). "Implications of sit-stand and active workstations to counteract the adverse effects of sedentary work: A comprehensive review," *Work* 52(2), 255-267. https://doi.org/10.3233/WOR-152168

Löfgren, M., and Witell, L. (2008). "Two decades of using Kano's theory of attractive quality: A literature review," *Quality Management Journal* 15(1), 59-75. https://doi.org/10.1080/10686967.2008.11918056

Luo, S., He, J., and Wang, J. (2013). "Comfort design of chair chassis with self-regulation and self-adaption," *Journal of Machine Design* 30(11), 97-100.
Nielsen, J. (1990). "A meta-model for interacting with computers," *Interacting with Computers* 2(2), 147-160. https://doi.org/10.1016/0953-5438(90)90020-I
Wütschert, M. S., Romano-Pereira, D., Suter, L., Schulze, H., and Elfering, A. (2022). "A systematic review of working conditions and occupational health in home office," *Work* 72(3), 839-852. https://doi.org/10.3233/WOR-205239
Yan, Y., Liang, Y., and Guan, H. (2025). "Kano-DEMATEL-TRIZ-based product design for nail tables and chairs: A two-category user study," *BioResources* 20(2), 3101-3117. https://doi.org/10.15376/biores.20.2.3101-3117
Young, I. (2008). *Mental Models: Aligning Design Strategy with Human Behavior*, Rosenfeld Media, New York, NY, USA.
Zhu, X., and Shek, D. T. (2020). "Impact of a positive youth development program on junior high school students in mainland China: A pioneer study," *Children and Youth Services Review* 114, article 105022. https://doi.org/10.1016/j.childyouth.2020.105022
Holzgreve, F., Maurer-Grubinger, C., Fraeulin, L., et al. (2022). "Home office versus ergonomic workstation - is the ergonomic risk increased when working at the dining table? An inertial motion capture based pilot study," BMC Musculoskeletal Disorders 23(1), 1-10.https://doi.org/10.1186/s12891-022-05704-z

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