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Research on Product Design of Assisted Employment for the Disabled Based on Kano QFD

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Abstract: *The purpose of this paper is to effectively obtain users' demand and weight for the auxiliary employment of the disabled, and determine the design requirements of the auxiliary employment products, so as to optimize the process of the auxiliary employment products for the disabled and promote the development of the employment of the disabled. The specific implementation process is as follows: First, use the user journey map to explore the user behavior path and obtain the initial user needs; Secondly, the user needs are classified by Kano model and the demand weight is determined; Finally, QFD completes the transformation between user requirements and design requirements, obtains design weights, and obtains key design goals by comparison. Through the combination of user journey map, Kano model and QFD model, this paper takes the Green Horse aided employment product for the disabled as an example to study, provide design basis and verify the feasibility of this method, and improve the aided employment product from the three dimensions of the disabled, product and buyer.*

Keywords: *Kano QFD model; User journey diagram; Auxiliary employment products for the disabled; User requirements; design requirement*

1. Introduction

In the Fourteenth Five Year Plan for the Security and Development of Disabled Persons, the State Council proposed to encourage disabled persons to obtain employment through new forms of employment, increase support and security for "Yangguang Homeland", "Home for the Disabled" and other auxiliary employment institutions, and organize disabled persons with employment difficulties, such as intellectual, mental and severely physical disabled persons, to participate in productive labor, carry out vocational rehabilitation, and achieve social integration, so as to promote the employment of the disabled[1]. Employment is the basic right of every citizen, including the disabled, and an important condition for them to realize a better life. At present, under the influence of multiple factors such as physiological barriers, environmental restrictions and social discrimination, the problem of "difficult employment" for the disabled has always been the focus of the work for the disabled. Assisted employment for the disabled is an important way for the disabled to participate in employment. Its main difficulties are: insufficient attention to the disabled and external resources, less orders for auxiliary employment, low income, and difficult popularization[2]. Adhere to the concept of taking the disabled as the center, regard meeting the employment needs of the disabled and improving their employability as a right of the disabled, rather than a gift or charity, and build an equal supporting employment mechanism for the disabled[3].

Assisted employment for the disabled is an important way for the disabled to participate in employment, but it has been in a state of backward products and low added value. Based on Kano and QFD models, this paper discusses the key needs of users in the research and development of assistive employment products for the disabled, and designs assistive employment products that meet the needs of the disabled. The advantage of user journey is to explore the real needs of users from the whole flow chart of users[4]; The advantage of Kano model lies in sorting out the classification and weight of user requirements designed, so as to obtain the demand hierarchy[5]; The advantage of QFD is to sort out the weight of design requirements, so as to guide the design direction[6],So as to guide the design to solve the dilemma of auxiliary employment and promote the equal employment of the disabled.

ISSN 2618-1568 Vol. 4, Issue 14: 77-86, DOI: 10.25236/FAR.2022.041415

2. Application of Kano QFD in auxiliary employment products

QFD model is the most widely used analysis method to link user requirements with design requirements. The QFD model can effectively transform the user needs of the disabled auxiliary employment products into design requirements, and determine the weight between the user needs and design requirements.Kano is a mathematical model for analyzing the classification and sequencing of multi-agent requirements. Kano model divides demand elements into five types: mandatory demand (M), desired demand (O), attractive demand (A), irrelevant demand (I) and reverse demand (R),as shown in Figure 1[7].

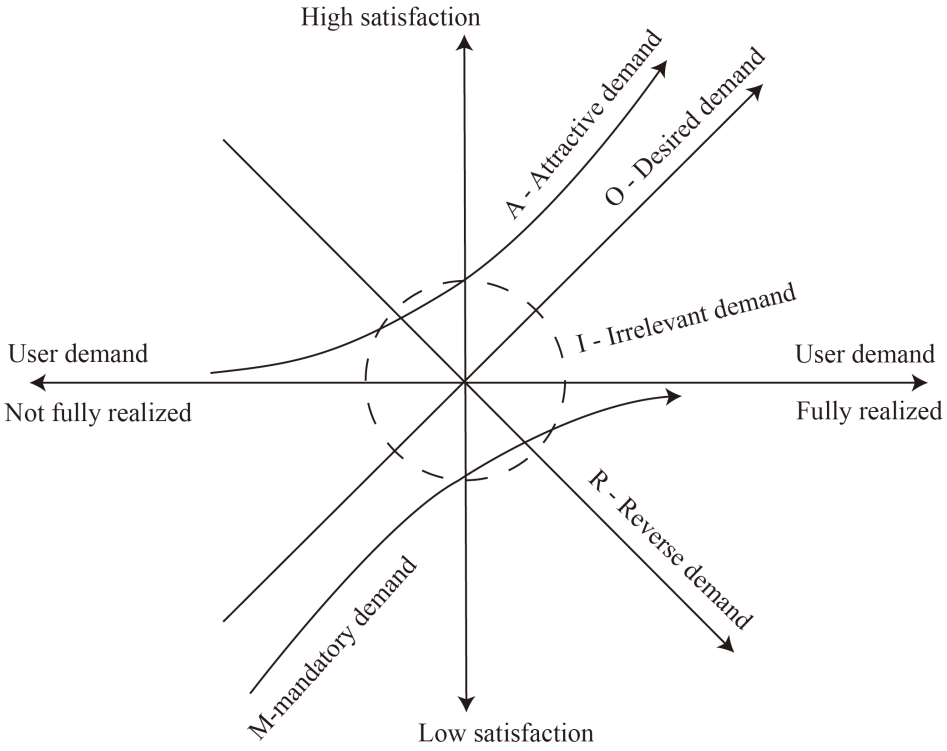

Figure 1: Kano model

In this paper, the initial needs of users are obtained through the user journey map of the auxiliary employment products for the disabled[8]. Karnaugh model is widely used in the research of demand classification and priority, and the nonlinear relationship between the design requirements of the auxiliary employment products for the disabled and the user needs can be obtained. However, Kano can only achieve qualitative analysis, with subjective errors. QFD uses quantitative analysis and matrix calculation to quantify the importance of user needs, making user needs and design requirements more real and clear. And it provides a powerful framework to transform user requirements into design requirements. It can provide the value information about which functions of the auxiliary employment products for the disabled need to be improved and optimized. Therefore, this paper chooses Kano and QFD methods to build a model to transform product requirements into design requirements, so as to identify the most critical performance indicators for product design, guide the design, and make the design reasonable.

3. Research methods and processes of research and development of assistive employment products for the disabled

3.1. Research methods based on Kano QFD model

At present, domestic assistive employment products for the disabled are in urgent need of the industry, and there is no systematic research process or particularly successful case. User needs and design requirements are still unclear. The process of auxiliary employment products for the disabled based on Kano QFD combination can obtain the initial needs and needs analysis of users through the user journey map, use Kano model to classify and filter the needs, and then obtain the importance of the needs, and use QFD model to achieve design transformation. The specific process includes: 1. Use the user journey map to obtain initial user demand; 2. Use Kano model to calculate the weight of user demand and find

ISSN 2618-1568 Vol. 4, Issue 14: 77-86, DOI: 10.25236/FAR.2022.041415

out the core demand; 3. Use QFD to transform user requirements into design elements.

3.2. Research process

The research process is carried out according to the research method in Figure 2, and the specific implementation is as follows: 4 steps,as shown in Figure 2.

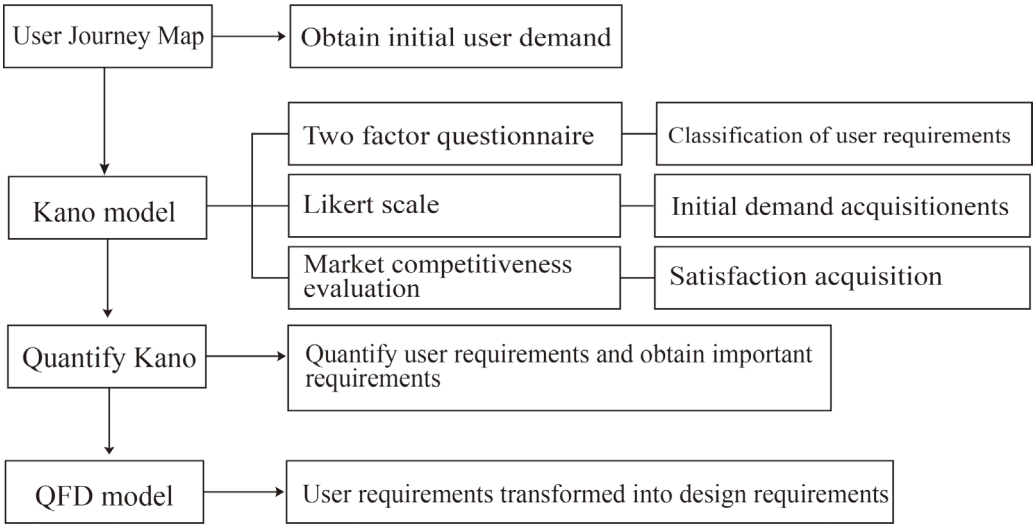

Figure 2: Assisted employment for the disabled research method

3.2.1. Obtain user demand elements based on user journey map

The User Journey Chart is a comprehensive chart to analyze the user's use behavior in the whole stage. It divides the auxiliary employment products for the disabled into different stages, Through observation and in-depth research, we can obtain the user's behavior path at different stages and the user's satisfaction with each behavior contact. Low satisfaction is the pain point, while high satisfaction is the pleasure point. Both the pain point and the pleasure point can be used as the initial demand points of the auxiliary employment products for the disabled.

3.2.2. Design user demand questionnaire based on Kano model

The initial demand elements of the auxiliary employment products for the disabled obtained according to the user journey map have subjective bias. Kano is a mathematical model for analyzing the classification and ranking of the needs of multiple agents, including a two factor questionnaire, a demand importance questionnaire and a market competitiveness assessment. The questionnaire is used to obtain relevant needs through data, making the initial needs more objective.

The two factor questionnaire can determine the Kano attribute of the user needs of the disabled auxiliary employment products. Kano model divides demand elements into five types: mandatory demand (M), desired demand (O), attractive demand (A), irrelevant demand (I) and reverse demand (R),as shown in Figure1. In the two factor questionnaire, positive and negative questions were used for each demand, and there were five types of answers. The Kano attribute of each requirement is determined according to the rating type with the largest number in the questionnaire.

The demand importance questionnaire adopts the 5-step Likert scale method to determine the importance of the initial demand of users of the auxiliary employment products for the disabled. The disabled are asked to give a grade of importance according to each demand point. The score ranges from 1 to 5, where 1 is the least important and 5 is the most important. Finally, the average value is the initial demand importance value H_i.

For the market competitiveness evaluation, the target object is asked to fill in a questionnaire to obtain the evaluation of the satisfaction of the disabled on the existing disabled auxiliary employment products and green horse auxiliary employment products in the market, so as to obtain the current satisfaction S_o and target satisfaction S_i.

3.2.3. *Quantify the importance of Kano model to obtain the end-user demand*

According to Kano demand classification of users' demands, the calculation formula of user

ISSN 2618-1568 Vol. 4, Issue 14: 77-86, DOI: 10.25236/FAR.2022.041415

satisfaction index T_i is as follows: (1), where SII=(A+O)/(A+O+M+I), DDI=- (O+M)/(A+O+M+I). When the | SII | value or | DDI | value tends to 0, the smaller the impact of this requirement on user satisfaction; When the trend is 1, the influence is greater[9].

$$T_i = \max(|SII||DDI|) \quad (1)$$

The current satisfaction value S_o and the target satisfaction value S_i of the auxiliary employment products for the disabled are obtained according to the market competitive evaluation, and the target improvement rate V_i of the demand satisfaction of the disabled can be obtained[10]. As shown in Formula (2).

$$V_i = S_o / S_i \quad (2)$$

In order to more accurately determine the importance of the demand for the auxiliary employment products for the disabled, the adjustment coefficient k is introduced. However, the demand of necessity, expectation and charm has a greater impact on user satisfaction, In combination with the research results of Chaudha A et al., therefore, the K values of necessary demand, expectation demand and charm demand are 0.5, 1 and 1.5. Based on Formula (1) and Formula (2), the demand adjustment improvement rate IR_i can be calculated[11], as shown in Formula (3).

$$IR_i=(1+T_i)k*V_i \quad (3)$$

Each disabled person is asked to give a score for the weight Hi of each demand. The score range is from 1 to 5. 1 is the least important, 5 is the most important, and the average is the final score of the user's demand weight. According to the demand, adjust the improvement rate IR_i and the user demand weight H_i, and solve the importance degree LR_i of the demand for the disabled auxiliary employment products[11], as shown in Formula (4).

$$LR_i = IR_i * Hi \quad (4)$$

3.2.4. *Obtain the weight of design requirements based on QFD model*

Transform the needs of the disabled into design requirements, fill the sorted design requirements and user needs into the QFD model, and determine the relationship between the design requirements and the needs of the disabled. The three symbols ●, ○ and △ can be used to represent the strong, medium and weak relationships in turn, and the calculated values are 9, 5 and 1 respectively.

According to LR_i in Formula (4) and Y_{ij} obtained from the quality function expansion matrix table, the importance degree W_j of design requirements can be obtained by Formula (5), and then the key design requirements can be determined by ranking the value of importance degree W_j of design requirements[12].

$$W_j = \sum_{i=j}^{m} LR_i * y_{ij} (j=1, 2, ..., n) \quad (5)$$

4. Case study on auxiliary employment products for the disabled

The problem of "difficult employment" for the disabled has always been the focus of the work for the disabled. Centralized employment, proportional employment and other traditional forms of employment support for the disabled have, to a certain extent, guaranteed the employment rights of the disabled. However, the employment problem of the mentally handicapped and some severely handicapped people is still a pain point that traditional employment support is difficult to solve. The research and development of auxiliary employment products can solve the problems of backward and low added value of mentally handicapped disabled employment products at the source, so as to expand the employment form of mentally handicapped people and improve the employment quality[13].

4.1. Analysis of the user journey map of the auxiliary employment products for the disabled

The main target users of the research and development of the auxiliary employment products for the disabled are the mentally disabled. The sample is 30 people, including 9 people with autism and 10 people with mental retardation.

The research and development of assistive employment products for the disabled can be divided into three stages: before production, during production and after production. According to the feedback information obtained from the interview, the user contact points, pleasure points and pain points at each stage are sorted out in the form of user journey maps. ,as shown in Figure 3.

ISSN 2618-1568 Vol. 4, Issue 14: 77-86, DOI: 10.25236/FAR.2022.041415

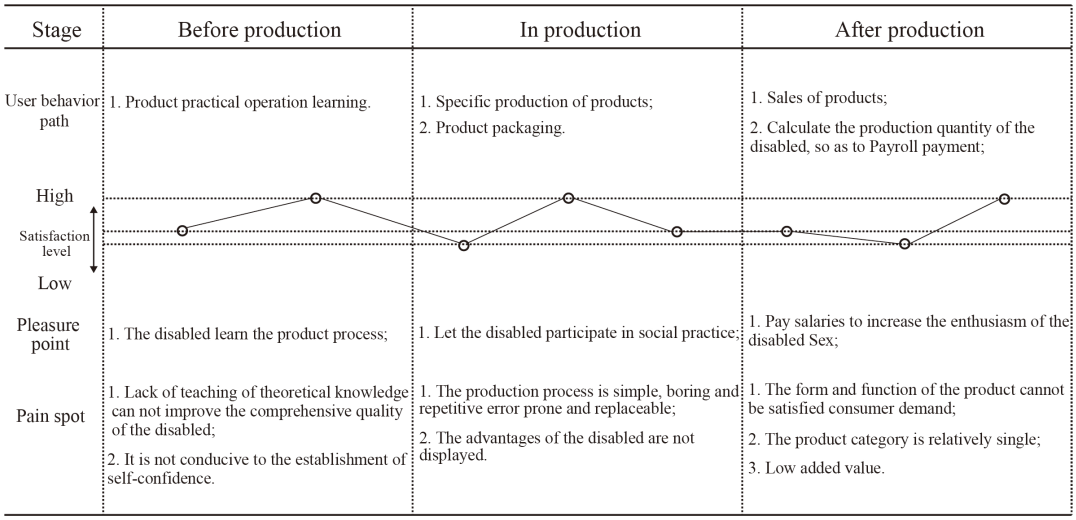

Figure 3: Assisted employment for the disabled user journey chart

As the demand points of the user experience map are vague and scattered, the KJ method is used to sort out the user's pleasure points and pain points as user needs into six categories: high product added value, smooth and simple operation, meeting the needs of buyers, learning new content, breaking through the original products, improving the sense of self-identity, and then transforming the first level needs into the second level needs.

Among them, “High product added value” C_1, can increase the unit price of auxiliary employment products, thus increasing the income of the mentally handicapped; “Smooth and simple operation ”C_2, which can provide more reasonable product production process for the disabled and further streamline the process, so that the product can be presented in a fast and good way; “Meet the needs of buyers” C_3, the original intention of the public to buy products is no longer just charity, but more to buy products to meet the daily use needs and aesthetic needs of the public; “Learn new content ”C_4, a teaching mode combining theory with practice. The auxiliary employment products present diversified forms of expression, enrich the skills of the disabled and carry out cultural output to broaden the ability boundary of the disabled; “Breaking through the original products” C_5, the design form can break through the original woven flowers, folding cartons, etc., and the product should move towards the direction of carrying cultural value; “Improve self identification” C_6, so that the disabled can learn not only practical operation ability but also theoretical knowledge in production, and promote the disabled to enhance their sense of self-identity through the improvement of their comprehensive ability,as shown in Table 1.

Table 1: Assisted employment for the disabled user need

Serial No	Level 1 requirements	Serial No	Secondary demand
C_1	High product added value	C_{11}	Increase added value
		C_{12}	Cultural input
		C_{13}	Technical input
C_2	Smooth and simple operation	C_{21}	Conforming to operation capability
		C_{22}	Process humanization
		C_{23}	Simple process
C_3	Meet the needs of buyers	C_{31}	functional requirement
		C_{32}	Aesthetic needs
C_4	Learn new content	C_{41}	Diversification of categories
		C_{42}	Cultural output
C_5	Break through the original products	C_{51}	Diversified design
		C_{52}	Break the inherent cognition
C_6	Improve self identification	C_{61}	Maximize capacity
		C_{62}	Information establishment

4.2. Kano questionnaire analysis of auxiliary employment products for the disabled

4.2.1. Two factor questionnaire and initial importance questionnaire analysis

A questionnaire was designed according to the 14 needs obtained from the user's journey map and

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distributed to the mentally disabled. According to the data of 70 valid questionnaires and Kano classification in Figure 1, the final questionnaire results are shown in Table 2.

Table 2: The questionnaire results

User demand	A	O	M	I	R	Demand Type	Importance of initial demand H_i
C_{11} Added value	27	11	32	0	0	M	4.82
C_{12} Cultural input	20	21	29	0	0	M	4.78
C_{13} Technical input	25	29	13	3	0	O	4.26
C_{21} Meets the operation capability	18	18	30	4	0	M	3.53
C_{22} Humanized process	10	12	35	8	5	M	3.21
C_{23} Simple process	19	20	28	3	0	M	3.86
C_{31} Functional requirements	19	24	27	0	0	M	4.03
C_{32} Aesthetic needs	21	22	23	4	0	M	3.18
C_{41} Diversification of categories	17	16	14	20	3	I	1.32
C_{42} Cultural output	25	15	14	14	2	A	1.83
C_{51} Diversified design	26	10	12	20	2	A	2.65
C_{52} Break the inherent cognition	11	35	13	8	3	O	2.54
C_{61} Maximize capacity	9	43	12	4	2	O	3.54
C_{62} Confidence building	15	33	17	5	0	O	4.63

4.2.2. Evaluation of market competitiveness

In this experiment, a 5-step Likert 5-point questionnaire was set up, and users were invited to rate the service satisfaction of the existing assistive employment products for the disabled as the current satisfaction value S_o. Secondly, the market competitiveness evaluation of this experiment selects traditional and new auxiliary employment products as the benchmark objects. In this experiment, 15 disabled persons with mental disorders were invited to score their service satisfaction and determine the target satisfaction value S_i.

4.3. Kano quantification of auxiliary employment products for the disabled

Table 3: The calculation results of Kano

User demand	Demand Type	T_i	Importance of initial demand H_i	IR_o	K	IR_i	Importance of final demand LR_i
C_{11} Added value	M	0.33	4.82	4.84	0	4.84	23.32
C_{12} Cultural input	M	0.42	4.78	3.51	0	3.51	16.77
C_{13} Technical input	O	0.46	4.26	1.92	0	1.92	8.16
C_{21} Meets the operation capability	M	0.35	3.53	1.14	0	1.14	4.04
C_{22} Humanized process	M	0.24	3.21	1.30	5	1.30	4.19
C_{23} Simple process	M	0.38	3.86	2.95	0	2.95	11.40
C_{31} Functional requirements	M	0.45	4.03	2.01	0	2.01	8.08
C_{32} Aesthetic needs	M	0.39	3.18	2.16	0	2.16	6.88
C_{41} Diversification of categories	I	0.22	1.32	0.58	3	0.58	0.76
C_{42} Cultural output	A	0.25	1.83	0.54	2	0.54	0.99
C_{51} Diversified design	A	0.17	2.65	1.90	2	1.90	5.04
C_{52} Break the inherent cognition	O	0.49	2.54	0.52	3	0.52	1.32
C_{61} Maximize capacity	O	0.62	3.54	1.25	2	1.25	4.45
C_{62} Confidence building	O	0.49	4.63	3.86	0	3.86	17.86

To sum up, the calculation of the final demand satisfaction LR_i of the auxiliary employment products for the disabled takes into account the satisfaction index of user demand, target improvement rate, demand adjustment improvement rate, various demand weight scores and other indicators, so it can comprehensively and objectively reflect the importance of the needs of the auxiliary employment

ISSN 2618-1568 Vol. 4, Issue 14: 77-86, DOI: 10.25236/FAR.2022.041415

products for the disabled. According to Formula (1-4), the corresponding values of various indicators with different demands are shown in Table 3.

4.4. Calculation of QFD model of auxiliary employment products for the disabled

4.4.1. Determination of design requirements

According to 14 secondary user requirements obtained from Kano model, the QFD model is used to convert them into corresponding 6 primary design requirements and 14 secondary design requirements, as shown in Table 4.

Table 4: Design requirement

Serial No	Level 1 requirements	Serial No	Secondary demand
D_1	Value added design	D_{11}	Extract design elements from traditional culture and current events
		D_{12}	Improve the technical difficulty of products
D_2	Product production process design	D_{21}	Make the process more suitable for the operation ability of the disabled
		D_{22}	Streamlined processes
D_3	User capability mining design	D_{31}	Assess the practical and cognitive abilities of the disabled
		D_{32}	Disassemble product task
D_4	Product appearance function design	D_{41}	Meet the functional requirements of the buyer
		D_{42}	Meet the aesthetic needs of buyers
D_5	Product interesting design	D_{51}	Innovation of product categories
		D_{52}	Theory and Practice Teaching of Culture and Design Concept
D_6	User value enhancement design	D_{61}	Establishment of encouragement and reward mechanism
		D_{62}	Break through the traditional product model of simplicity and repeatability, and move towards improving comprehensive capabilities
		D_{63}	The product is easy to produce results

4.4.2. Establish the relationship between design requirements and user requirements

Table 5: Assisted employment for the disabied a matrix of relationships between user requirements and design requirements

Design requirement / User Requirements		Importance LR_i	D_1		D_2		D_3		D_4		D_5		D_6		
			D_{11}	D_{12}	D_{21}	D_{22}	D_{31}	D_{32}	D_{41}	D_{42}	D_{51}	D_{52}	D_{61}	D_{62}	D_{63}
C_1	C_{11}	23.32	●	●					●	●	●			●	△
	C_{12}	16.77	●	△						●	○	●		○	
	C_{13}	8.16	△	●					○	△	○			○	
C_2	C_{21}	4.04		○	●	○	●	●						○	●
	C_{22}	4.19		△	●	○	○	●						△	○
	C_{23}	11.40		△	○	●	○	△						△	●
C_3	C_{31}	8.08		○					●		△			△	
	C_{32}	6.88	●	△						●	△			△	
C_4	C_{41}	0.76	△						○	○	●				
	C_{42}	0.99	●							△		○		●	
C_5	C_{51}	5.04	●	●				●	△	○	○				
	C_{52}	1.32	△	△					○	△	△	○		●	
C_6	C_{61}	4.45			●	○	●	●					●	●	○
	C_{62}	17.86	○	○	○	△	●	●	○	○		●	●	●	○
	ImportanceW$_j$		596.18	497.26	198.54	104.62	253.22	253.22	503.17	576.14	425.92	340.67	172.62	607.67	215.54
	Importance rankingW$_j$		2	5	11	13	9	8	4	3	6	7	12	1	10

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According to the user needs and design needs of the disabled auxiliary employment products, a rectangular model of the House of Quality is established. The left wall and ceiling of the House of Quality are the user needs and design needs of the disabled auxiliary employment products[6]. Organize disabled persons and designers to score the degree of correlation between user needs and the design requirements of assistive employment products for disabled persons. The score with strong correlation is 9, expressed by ●; The general score of correlation is 5, which is denoted by ○; The score of weak correlation is 1, expressed by △. Combined with Formula (5), the importance of design requirements can be calculated. The calculation results are shown in Table 5.

According to the user requirements and design requirements, the House of Quality figure shows that among the top five design requirements, D_{62} is the design requirement for improving the comprehensive ability of the disabled, D_{11} and D_{12} are the design requirements for improving the added value of products, and D_{41} and other D_{42} are the design requirements for target buyers. Among them, the core design requirement for the disabled is to "break through the traditional product model of simplicity and repeatability and move towards improving comprehensive capabilities" D_{62}. The auxiliary employment products are not only concerned with the improvement of the practical operation ability of the disabled, but also should pay more attention to the improvement of the cognitive category of the disabled. The design orientation should be the combination of practice and theory, so that the disabled can be improved from the practical ability and cognitive aspects, And then enhance the self-confidence of disabled people; "Extract design elements from traditional culture and current events" D_{11} and "Improve the technical difficulty of products" D_{12} are the core of enhancing added value. Design elements, concepts, technologies and other design elements should be fully considered in design conception and research and development. "Meet the functional requirements of the buyer" D_{41} and " Meet the aesthetic needs of buyers " D_{42} are the core design elements of the purchase intention of the target object. The design should consider the aesthetic tendency and daily functional needs of the buyer.

5. Case Design of Green Horse Assisted Employment Products for the Disabled

Based on the QFD model, the ranking results of the importance of the design requirements are obtained. The design focuses on the confidence building of the disabled, the design to enhance the added value, the design to meet the needs of target buyers and other elements, providing design guidance for the Green Horse auxiliary employment products, so as to help the disabled to move towards the employment direction of improving their comprehensive ability and high added value.

Therefore, the overall Green Horse auxiliary employment products will improve the user satisfaction of the products from the three dimensions of the disabled, products and buyers.

From the perspective of the disabled, the priority design of Green Horse's auxiliary employment products for the disabled requires "break through the traditional product model of simplicity and repeatability and move towards improving comprehensive capabilities" D_{62} is to improve the comprehensive ability of the disabled. The auxiliary employment for the disabled should not only be limited to products, but also focus on the disabled. The research and development of auxiliary employment for the disabled should be carried out in a way that combines theoretical courses with practical courses. Therefore, lectures and activities on the design concept of green horses and epidemic publicity knowledge are added in the design and development of green horses. Theoretically, through courses and activities, it can alleviate the boredom in the transmission of theoretical knowledge, broaden the understanding of the mentally handicapped people on the design concept of the Green Horse and epidemic knowledge, broaden the knowledge of the disabled, and let the mentally handicapped people understand and integrate into the society; In practice, handmade drip products enrich the forms of auxiliary employment products, break the traditional repetitive products with high added value and low added value, and the interesting, high added value and remarkable achievements of the process can stimulate the enthusiasm of the disabled and help to establish the confidence of the mentally handicapped.

From the perspective of products, "Green Horse" auxiliary employment products give priority to "Extract design elements from traditional culture and current events" D_{11} and "Improve the technical difficulty of products" D_{12}, Therefore, in the research and development of the auxiliary employment products of Green Horse, we will focus on how to innovate on the cultural value of design elements and the technical difficulty of products. In terms of cultural value, first of all, the epidemic situation has been puzzling our normal life at this stage, and we are spreading anti epidemic knowledge all over our lives. The idea of taking the current anti epidemic events as the auxiliary employment products for the disabled is to make some contributions to the epidemic publicity and realize the output of cultural and social

ISSN 2618-1568 Vol. 4, Issue 14: 77-86, DOI: 10.25236/FAR.2022.041415

values; Secondly, apply for the appearance copyright of the "Green Horse", and finally donate the "Green Horse" copyright to the foster care institutions free of charge, so that the disabled can own their own cultural copyright. For the uniqueness of copyright and the granting of cultural value, so as to enhance the added value of products. Technically, the original products with high repeatability and low technical difficulty will be upgraded to hand made drip products. The product process includes injection molding, modulation, demoulding, polishing and polishing. The disabled need to complete the "Green Horse" auxiliary employment products with the help of our material package, making the products less replaceable.

From the perspective of buyers, the "Green Horse" auxiliary employment products give priority to the decisive factors of the purchase intention of the target objects, which are "Meet the functional requirements of the buyer" D_{41} and " Meet the aesthetic needs of buyers " D_{42}, Therefore, in terms of function, the design combines modern people's living habits to make the product into a key chain commonly used in people's daily life, so as to realize the practical concept of the product; From the aspect of appearance, the green horse will simplify the shape of the horse under the condition that the basic appearance features remain unchanged, so that the design conforms to the simple aesthetic concept of modern people.

6. Conclusion

In this paper, Kano and QFD models are used together to obtain the initial user demand through the user journey diagram; Then, the KJ and Kano models are used to classify the user needs and rank the importance of the user needs; Finally, QFD model is used to convert the quantified user requirements into design requirements, and quantify and rank their weights. Through qualitative and quantitative analysis, we can avoid the subjective consciousness deviation caused by the designers' analysis of the user's needs in the early stage, provide a summary and research method of the user's needs and design requirements for the research and development of auxiliary employment products for the disabled, and provide a theoretical reference for the designers of auxiliary employment products. User requirements will change with people's changing lives, requiring designers to constantly optimize and iterate. However, in the production process with limited resources, user requirements and design elements with high weight should be considered. The follow-up research can continue to improve the design requirements of the auxiliary employment products for the disabled, so as to improve the feasibility of the design scheme.

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