

# Art Health Product Design and User Experience Optimization Based on Fuzzy Algorithm

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With the improvement of living standards, consumers' demand for health products that have both aesthetic qualities and health functions is increasing. However, due to the diversity and uncertainty of user needs, traditional design methods are unable to meet personalized and multidimensional design requirements. Hence, this study discusses the art health product design and user experience optimization based on fuzzy algorithm. The fuzzy algorithm quantifies the user requirements, builds the optimization model, and achieves the design optimization of functionality, appearance design, comfort and other dimensions. The results show that the fuzzy algorithm can significantly improve user satisfaction in terms of functionality, comfort and ease of use. After further analysis of user feedback, the research proposes future optimization directions in regard to personalized regulation and material improvement. Therefore, the research provides scientific theoretical support and practical reference for the innovative design of art health products, and helps to enhance user satisfaction with the product, and strengthen its market competitiveness.

Keywords: fuzzy algorithm; art health products; user experience optimization

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## 1. INTRODUCTION

With the improvement of people's living standards and increased health awareness, art health products, that combine art aesthetics and health functions, have gradually attracted the attention of consumers. These kinds of products not only incorporate artistry in appearance design, but also strive to meet the needs of consumers in terms of health benefits, comfort and spirit in functional design. Therefore, the design and optimization of art health products have become a hot topic of current research.

Wang and Hu pointed out that the application of artificial intelligence and related algorithms in user experience optimization significantly improves the efficiency and accuracy of product design [1]. Yu emphasized the importance of user experience design in interaction optimization and waiting experiences, particularly in complex environments [2]. Zhu

et al. further proposed that the combination of emotional design and algorithmic models can achieve a more precise alignment between functionality and user needs [3]. Zhao et al. investigated the application of fuzzy algorithms in virtual scenarios and health products, concluding that this method effectively addresses the challenge of multi-dimensional demand analysis in product development [4]. Li et al. examined the optimization role of fuzzy logic in smart home products, discovering that the algorithm enhances the sustainability and precision of user experience [5].

As an efficient mathematical tool, fuzzy algorithms can handle fuzzy uncertainties and complex multi-dimensional data, making them highly valuable for optimizing product design. Gorski et al. demonstrated the application of fuzzy algorithms in recommendation systems, providing more targeted user suggestions in complex data environments [6]. Blanchard explored user experience optimization methods in the development of digital health products, highlighting the unique advantages of fuzzy algorithms in data-driven

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decision-making [7]. Velciu et al. emphasized that combining user-driven approaches with fuzzy logic enables precise matching of technological interventions with the needs of aging populations [8].

When designing artistic health products, it is crucial to optimize user experience. Cho et al. suggested that content optimization methods based on algorithms can effectively predict user behavior and preferences, and provide data support for product design [9]. Zhang and Xiong found that the integration of deep learning and fuzzy logic helps enhance user engagement and improve products' market performance [10]. These studies provide theoretical and practical support for the application of fuzzy algorithms in the design of artistic health products.

This paper explores the design of art health products and user experience optimization path through the application of a fuzzy algorithm, and aims to improve the market competitiveness and user's satisfaction with products. Specifically, this paper first theoretically analyzes the definition, characteristics and fuzzy algorithm of art health products, and then proposes a design scheme for art health products based on a fuzzy algorithm, and then discusses the path and method of user experience optimization. Finally, through practical case analysis, this paper verifies the effectiveness of the fuzzy algorithm in the design of art health products.

## 2. THEORETICAL BASIS

### 2.1 Definition and Characteristics of Art and Health Preservation Products

Artistic wellness products are an innovative type of product that combines artistic aesthetics with health-related functionalities, aiming to meet both the physical and psychological needs of users through unique designs. These products not only pursue artistic appeal and aesthetics in appearance but also emphasize practical benefits for health and wellness, making them highly attractive in the modern consumer market. According to Uzir et al., the success of such products relies not only on their functionality and aesthetic design but also on enhancing user experience and satisfaction through intelligent design [11]. Research by Heshmati et al. suggests that artistic wellness products can improve usability and acceptance in health information systems by optimizing methods for measuring user experience [12].

Luo et al. emphasized the importance of effective interactive design strategies in optimizing product design to enhance user engagement and experience, particularly in the health sector [13]. Cho et al. demonstrated that algorithmic content optimization can effectively predict user behavior preferences, providing support for the personalized design of artistic wellness products [14].

Cultural relevance is another notable characteristic of artistic wellness products. Many designers integrate traditional cultural elements into product designs to convey specific cultural meanings. For instance, combining local art styles with user preferences not only enhances the emotional value of the products, but also strengthens users' brand recognition

[13, 14]. This fusion of culture and technology provides artistic wellness products with greater market competitiveness and differentiation advantages.

In short, art health products meet the multiple needs of consumers in terms of health, aesthetics and emotion through the combination of functionality, artistry and culture. The emergence of such products reflects modern people's pursuit of a high quality of life, and provides a new creative direction and innovation space for the design field.

### 2.2 Overview of The Fuzzy Algorithm

The fuzzy algorithm is a method based on fuzzy set theory, and is used to handle data information containing uncertainty or ambiguity. Unlike traditional accurate algorithms, fuzzy algorithms can handle incomplete explicit system information, especially suitable for complex decision-making, classification and reasoning problems. In the design of art health products and user experience optimization, the fuzzy algorithm can help designers to better understand and meet the multi-dimensional needs of users through the processing of fuzzy data [15].

The core idea of the fuzzy algorithm is the fuzzy set. Traditional set theory requires that each element either belongs to or is not the set, while fuzzy sets introduce the notion of membership. The membership function is used to describe the degree of membership of the element  $x$  to the set  $A$ . The values range between 0 and 1, indicating the degree to which the element part belongs to the set. The mathematical expression for the membership function is:

$$\mu_A(x) \quad X \rightarrow [0, 1] \quad (1)$$

The term  $\mu_A(x) = 1$  indicates that an element fully belongs to set  $A$ ,  $\mu_A(x) = 0$  indicates that an element does not belong to set  $A$  at all, and  $0 < \mu_A(x) < 1$  values between 0 and 1 indicate partial membership in set  $A$ .

In fuzzy inference, the fuzzy rule is usually represented by the "if-then" structure. For example, in the design of art health products, we can construct the following fuzzy rules, as shown in Eq. (1):

$$IF x \text{ is an elegant design, } y \text{ is high user satisfaction} \quad (2)$$

Here, the "elegant design" and "high user satisfaction" are both fuzzy concepts, using the fuzzy set and membership to describe its specific degree. The fuzzy logic operation includes the basic conjunction (AND), evolution (OR) and complement (NOT) operations, which are defined as follows:

Fuzzy conjunction (AND): If there are two fuzzy sets  $A$  and  $B$ , and  $\mu_A(x)$  and  $\mu_B(x)$  are respectively and, then the result of the conjunction operation is Eq. (3).

$$\mu_{A \cap B}(x) = \min(\mu_A(x), \mu_B(x)) \quad (3)$$

Fuzzy analysis (OR):  $\mu_A(x)$ ,  $\mu_B(x)$  means that any condition is satisfied. The resulting membership function is obtained with Eq. (4):

$$\mu_{A \cup B}(x) = \max(\mu_A(x), \mu_B(x)) \quad (4)$$

Fuzzy complement (NOT): indicates the negation of the condition, and the resulting membership function is obtained with Eq. (5):

$$\mu_{\neg A}(x) = 1 - \mu_A(x) \quad (5)$$

In the fuzzy inference system, the input data is first blurred into a fuzzy set, then logical reasoning is conducted according to the fuzzy rules and, finally, the result is converted into an exact value through deblurring. The commonly-used deblurring method is the center of gravity method (centroid method), which is Eq. (6):

$$y = \frac{\int_{\Omega} y \cdot \mu(y) dy}{\int_{\Omega} \mu(y) dy} \quad (6)$$

Here,  $\Omega$  is the domain of the output variable,  $\mu(y)$  is the membership function, and  $y$  is the precise output value after defuzzification. The centroid method calculates the centroid of the fuzzy output to obtain a single output value, which is particularly useful for quantitative evaluation in user experience optimization.

In short, the design of a fuzzy algorithm can help designers to deal with uncertainty and fuzzy needs and user experience optimization in the art and health products, so as to achieve the design and evaluation aligned with user needs. This approach is particularly suited to dealing with multi-dimensional optimization problems of user preferences and perceptual experience.

## 2.3 User Experience Theory

User experience theory refers to the overall feelings and reactions of users when using certain products or service. This theory originates from human-computer interaction and psychology, and emphasizes the subjective experience formed in the interaction between users and products, covering the users' feelings in many physiological, emotional, psychological and other aspects. User experience is not only a single evaluation of product functions, but also a multi-dimensional comprehensive experience of product appearance, ease of use, interaction and emotional satisfaction.

According to user experience theory, user experience consists of the following core elements:

**Practicality (Usability):** One of the basic elements of user experience refers to whether the product can meet the actual functional needs of users. A product with high practicality can allow users to easily and effectively complete the required tasks and reduce operational obstacles.

**Affection (Emotional Value):** Emotion is an important part of user experience, and refers to the emotional satisfaction that users obtain when using products, such as pleasure, relaxation or excitement. Emotion is often conveyed to users through the appearance design, interaction mode and tactile sense of products, so as to improve the user experience.

**Aesthetics:** The aesthetic nature of a product refers to its visual and sensory appeal. Visual beauty can enhance the attractiveness of the product, so that users can obtain a pleasant sensory experience when using it. Aesthetics is especially important in art products, as it not only heightens the pleasure

experienced by the user, but also may enhance the users' emotional identity with the product.

**Ease of Use:** Ease of use refers to whether the user can easily and quickly master the use of the product. Products that are easy to use reduce the users' cognitive load, making them more efficient and relatively effortless to use. Through intuitive design, simplified interaction processes can enhance the ease of use.

**Accessibility:** Accessibility refers to whether a product can be used by a variety of user groups, especially those with different physical conditions or special needs. Products with high accessibility can meet a wider range of user needs, increasing the inclusiveness and universality of the product.

User experience theory combines users' physiological and psychological needs with their emotional needs, helping designers to better understand the multi-dimensional requirements of users prior to product design, and then developing products that meet users' expectations. This theory is widely used in the field of product design, service design and human-computer interaction, and is an important theoretical basis for improving user satisfaction and enhancing product competitiveness.

## 3. ART HEALTH PRODUCT DESIGN BASED ON FUZZY ALGORITHM

### 3.1 Setting of The Fuzzy Algorithm in Product Design

#### 3.1.1 Fuzzy Optimization of The Product Appearance Design

In order to ensure that the appearance design not only meets functional needs, but also has aesthetic appeal, so as to enhance the overall value and market competitiveness of the product, this paper uses a fuzzy algorithm to optimize the product appearance, and comprehensively evaluates the design scheme through multi-dimensional and multi-level standards.

##### (1) Fuzzy and optimization of visual beauty

Visual beauty is one of the core elements of art health product design, and users usually have a preliminary emotional response to the product through the appearance design. In this study, the visual aesthetics in the design was quantified and optimized by the fuzzy algorithm. Specifically, the designer first determines the key visual elements in the product appearance design, such as color collocation, shape design and material texture. Next, the performance of each design scheme on these visual elements was evaluated using the fuzzy membership function. For example, for the color collocation, the membership function measures the users' satisfaction with different color combinations. The range of the membership value is [0,1], indicating the users' preference for the color collocation.

##### (2) The fuzzy treatment of aesthetic standards

The aesthetic standard of appearance design usually includes the users' visual attraction, overall coordination and artistic style preference of the product. Due to the ambiguity and subjectivity of these standards, using fuzzy logic to

process the aesthetic standards can effectively transform the evaluation of different users into quantitative evaluation indicators. In order to deal with this problem, this study establishes aesthetic evaluation dimensions, including the fluency of product lines, the harmony of color and the modern sense of form. The evaluation criteria for these dimensions are blurred by the user feedback data, and each dimension of the design scheme is represented by the membership function. Finally, the evaluation results of these dimensions are integrated to obtain a comprehensive aesthetic score.

#### (3) The fuzzy integration of user preferences

User preferences play a decisive role in appearance design, and the visual needs differ among different user groups. In order to effectively integrate these requirements, this paper analyzes the visual preferences of different user groups by collecting a large amount of user feedback data. For example, the age, gender, or cultural backgrounds of users may determine their preferences for color, shape, and materials. With fuzzy algorithms, designers are able to translate this preference information into quantifiable data and optimize the appearance design of the product to maximize user satisfaction.

#### (4) The specific implementation steps of fuzzy optimization

**Standard setting:** this is done to clarify the key evaluation criteria for the appearance of the product (such as color, shape, material, etc.).

**Membership function construction:** the membership function is established for each evaluation standard, and the fuzzy standard is transformed into quantifiable data for comprehensive evaluation.

**Weight allocation:** the weight of each standard is allocated according to the design objectives and user needs to ensure that the influence of different standards on the final design scheme is reasonable.

**Evaluation and optimization:** the performance of each design scheme according to multiple criteria is comprehensively evaluated by the fuzzy weighted average method so as to select the optimal scheme.

Through the above fuzzy optimization process, designers can find a balance between visual effects, user preferences and aesthetic standards, so as to design the appearance of art health products that both meet the functional needs of users and have market appeal. This optimization method strengthens the product's market competitiveness and improves the emotional satisfaction and brand loyalty of the users.

### 3.1.2 Fuzzy Optimization of The Product Function Design

In the design of art health products, functionality is one of the key factors used to determine the success of the product market. A successful art health product should not only have an attractive appearance, but also provide effective health benefits to users in terms of practical use such as relaxation, decompression, and sleep improvement. In order to ensure that the functionality of the product meets the needs of users, this study uses the fuzzy algorithm to optimize the functional design of the product, so as to achieve more accurate functional matching requirements and optimization.

#### (1) Fuzzy processing of functional requirements

The functional needs of users for art health products are usually uncertain and ambiguous. For example, users' expectations for relaxation vary from person to person, and some users may focus more on the intensity of the feature, while others may be more focused on its duration and comfort. In this case, the traditional precise design method is unable to fully consider the diversity and personalized characteristics of user needs. To address this problem, this study transforms different functional requirements into membership values by applying a fuzzy algorithm to quantify and handle these fuzzy requirements.

In the specific implementation, the designer blurred each functional standard through the fuzzy membership function. For example, when designing massage effects, functional evaluation criteria may include aspects of functional strength, duration, and comfort. Through the membership function, designers can translate the different levels of these standards into quantitative data to better meet the needs of different users.

#### (2) Weight allocation of functional standards

In the functional design of art health products, the weight of different functional standards will vary according to the specific needs of users. In order to better tailor product functions to users, this paper determines the relative importance of each function standard through user research and market analysis. For example, for products that focus on stress reduction, massage strength and comfort may be the more important criteria, while for users who need to improve their sleep, duration and mute design may be more weighted. In order to reasonably allocate the weights of each functional standard, the fuzzy weighted average method is used to combine the weights of each functional standard with the membership function to comprehensively evaluate the different design schemes.

#### (3) The fuzzy integration of user preferences

User preference also plays a crucial role in product function design. Different user groups have different requirements for product functions, and the fuzzy algorithm can effectively integrate the feedback data from different user groups so as to provide more accurate guidance for functional design. In this study, despite the ambiguity of large user feedback data, designers can identify the preferences of different user groups on health functions, such as the strength of massage, comfort or the need for heating functions.

Through the fuzzy algorithm, we are able to translate these preferences into quantitative data and integrate them into the product functional design scheme to ensure that the design scheme meets the widest range of user needs as possible. In the process of integration, the fuzzy algorithm can deal with the uncertainty and difference in user preferences, and maximize the universality and personalization of the design scheme.

#### (4) The specific implementation steps of fuzzy optimization

**Function standard setting:** according to user requirements and market analysis, the key standards of product functions, such as massage strength, comfort, heating function, etc. are determined.

**Membership function construction:** the membership function is established for each functional standard, and the fuzzy standard is transformed into quantifiable data for optimization evaluation.

**Table 1** Appearance design scheme.

Design Element	Design Requirements	Chosen Plan	Optimization Results
Color Matching	Matches the health and wellness attributes, warm colors such as beige and light gold	Combination of warm tones and wood-like colors	Enhances visual comfort, increases emotional resonance
Shape Design	Streamlined design, ergonomic, avoids sharp shapes	Soft curves and streamlined design	Increases comfort and aesthetics, enhances user experience
Material Choice	Conveys a natural and healthy feel, with high-quality material texture	Combination of wood and ceramic	Improves material sensory effect and aligns with health and wellness product attributes

Weight allocation: according to the influence of different functional standards on user needs, the weight of each standard is allocated to ensure the rationality of the final design scheme.

Evaluation and optimization: Through the fuzzy weighted average method, the performance of each design scheme according to multiple functional criteria is comprehensively evaluated to select the optimal scheme.

(4) Results analysis and design optimization

Through the fuzzy optimization process, designers are able to comprehensively consider the balance between functionality, user needs and design objectives, optimizing product functions to meet a wider range of user needs. This optimization process not only helps designers to make scientific decisions in terms of functionality, but also achieves more personalized design to meet diverse needs. This improves the overall performance and market competitiveness of art health products.

### 3.2 Design Scheme of Art and Health Preservation Products

#### 3.2.1 Appearance Design Scheme

In this study, the appearance design scheme of art health products is adjusted through fuzzy optimization method to ensure that the products can attract target users and convey the concept of health preservation.

First of all, color matching is one of the important elements of a product’s appearance, so warm colors, such as beige and light gold, with wooden colors are chosen to convey natural, comfortable and positive emotions. This color combination not only meets the functionality of health products, but also improves the visual pleasure of users.

In terms of morphological design, this scheme adopts streamlined and soft curve design to avoid a shape that is too complex and sharp-edged. The streamlined form design not conforms to the principle of ergonomics and also makes the appearance of the product appear modern and gentle, appealing to the users’ notion of comfort.

In the selection of materials, the scheme chooses the combination of natural wood and ceramics, which not only aligns with the concept of health preservation, but also enhances the tactile sense and visual appeal of the product. Wood and ceramic materials convey a sense of naturalness and also bring a unique texture and artistic sense to the product, enhancing its overall value.

By means of the fuzzy optimization method, combined with user preferences and market trends, the design scheme achieves an ideal balance in the choice of color, form and material. Fuzzy optimization ensures that each design element can accurately reflect the aesthetic and functional requirements of users, so that the design scheme not only meets the expectations of target users’ aesthetic preferences, but also effectively improves the market appeal and emotional resonance of the product.

Table 1 shows the specific optimization scheme of color collocation, form design and material selection, and its evaluation criteria. The performance of each design element under different criteria was quantified as membership values, ensuring that the design results were maximized in accordance with the users’ requirements.

In regard to the diversity of user needs, fuzzy optimization also helps designers to integrate the preference data of users of different gender and age groups. Through the analysis of a large amount of user feedback, the design scheme can be adjusted in terms of color, form and selection of material, making it more personalized according to user preferences. Especially for users of different ages and genders, the design scheme has been adjusted accordingly to ensure that the appearance attracts young users while meeting older people’s comfort requirements.

#### 3.2.2 Functional Design Scheme

In the functional design of art health products, the key goal is to ensure that the functionality of the product can effectively meet the health needs of users, while complementing the appearance design of the product. Through the fuzzy optimization method, this study optimizes the health effect, operation convenience and user comfort in the functional design, ensuring that the design scheme can provide efficient health outcomes and improve the user experience.

In the functional design, the massage itself is one of the core functions. According to the user needs, the design scheme is optimized for massage strength, massage duration and massage parts. The fuzzy algorithm was applied to process the users’ preference data, determine the adjustable range of the intensity of massage, and ensure that the massage effect met the needs of different users, whilst maintaining the comfort level and not being too vigorous.

The heating function was optimized to help users relax the body and improve the health benefits during use. Through fuzzy optimization, multi-gear heating temperature setting was designed so that users could choose the most appropriate

**Table 2** Functional design scheme.

Design Element	Design Requirements	Chosen Plan	Optimization Goal
Massage Effect	Meet the massage needs of different users, such as intensity, duration, etc.	Adjustable massage intensity and duration, with multiple massage modes available	Provide a comfortable massage experience, ensuring all user needs are met
Heating Function	Provide suitable temperature to help users relax their bodies	Multi-level temperature control, adjustable based on user needs	Enhance user comfort and improve relaxation effects
Ease of Use	Simple, intuitive design for easy operation	One-touch start, simplified operation process, intuitive control interface	Improve product usability, reduce user learning curve, and enhance user experience

level of heat according to their own needs to ensure a comfortable temperature range and maximize relaxation.

Convenience of operation is another important design goal. In order to improve the user experience, the functional design scheme was greatly optimized to simplify the operation process. An intuitive button layout, simple control interface and one-click start design, ensured that users could easily operate and enjoy the benefits of functions without complex operation steps.

Through fuzzy optimization, the functional design was carefully adjusted in terms of multiple dimensions to ensure that the diverse needs of different user groups were met. Table 2 presents the key functional optimization schemes for functional design and their design objectives.

Through fuzzy optimization, these functional design schemes enable the functions of the product to not only meet the requirements of health preservation, but also can provide a pleasant user experience. The function and appearance design complement each other, providing users with an efficient, comfortable and easy to operate product. Each design decision is based on the users' needs and feedback, ensuring that the final functional design scheme can meet the diverse needs of users.

## 4. RESEARCH ON USER EXPERIENCE OPTIMIZATION BASED ON FUZZY ALGORITHM

### 4.1 Questionnaire Design and Survey

In this study, the questionnaire was designed to collect user feedback on art health products to help understand the user experience, needs and preferences in the process of using the product. The questionnaire covered many aspects of functionality, design, comfort, ease of use to ensure a comprehensive understanding of user needs and satisfaction with the product. At the same time, the representativeness of the sample and the universality of the data was ensured.

#### (1) Design of the questionnaire

The questionnaire included items related to the following dimensions:

Functionality: user satisfaction and needs related to product functionality

Appearance design: user preference for product appearance, color and shape.

Comfort: the comfort of users when using the product.

Ease of use: whether the operation of the product is convenient, whether the interface is intuitive.

Emotional response: the users' emotional response (such as relaxation, pleasure, etc.) when using the product.

The questionnaire was quantified on the Likert scale ranging from 1 to 5, anchored by "very unsatisfactory" (1) to "very satisfied" (5). The questionnaire also contained open-ended questions that allowed users to provide specific feedback and suggestions, and these qualitative data help to provide insight into participants' real needs and pain points.

#### (2) Survey subjects

The respondents included 60 users, covering groups with different gender, age distribution, educational background, occupation and health product usage. The gender ratio of 1:1.30 men and women, ensured a gender balance to more comprehensively study experience differences across gender groups. The other demographic information is given in Figures 1 to 4.

#### (3) User Preference Extraction

After ascertaining user preferences, the feedback data from different user groups (Figure 5 and Figure 6) revealed significant differences in preferences across dimensions such as functionality, comfort, appearance design, usability, and emotional response. The following is an analysis based on user groups and age segments:

As shown in Figure 5, there are significant differences in scores across dimensions between male and female users.

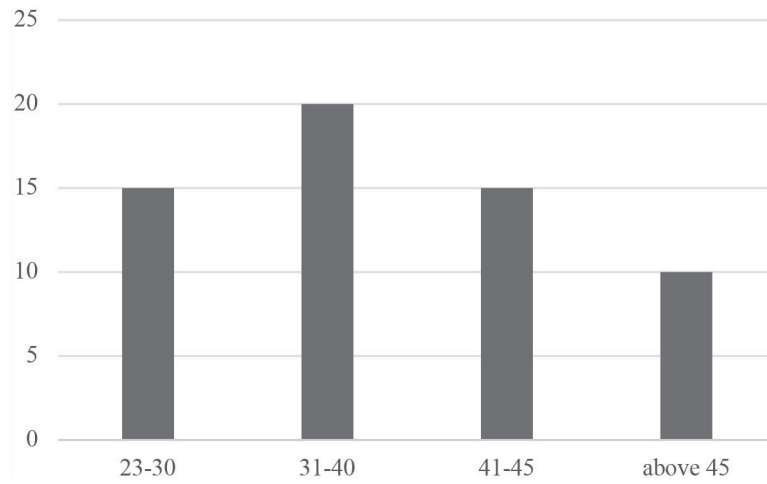
Functionality: Female users scored higher in functionality (0.88) compared to male users (0.82), indicating that females place greater emphasis on the product's effectiveness in meeting health and wellness needs.

Comfort: Female users also rated comfort higher (0.80) than male users (0.75), suggesting that women prioritize comfort when using the product.

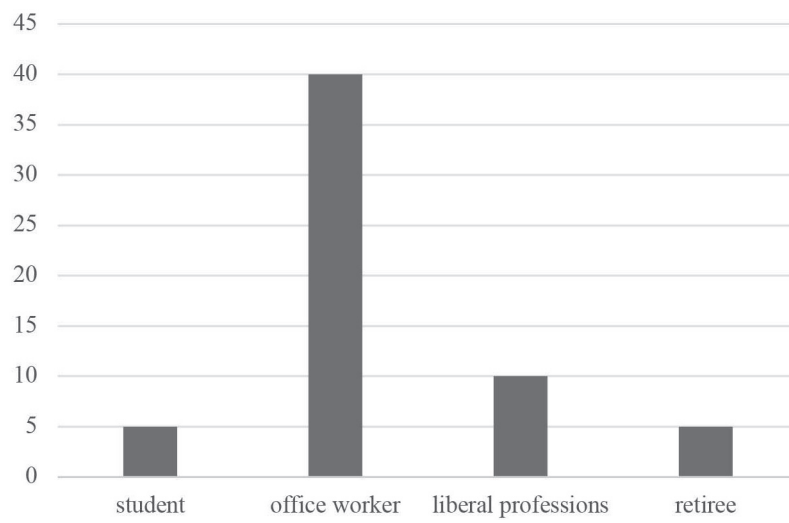
Appearance Design: Male users scored lower in appearance design (0.68) compared to female users (0.75), indicating that women are more sensitive to the visual appeal of products.

Usability: Female users (0.72) rated usability slightly higher than male users (0.70), reflecting a preference for user-friendly designs among women.

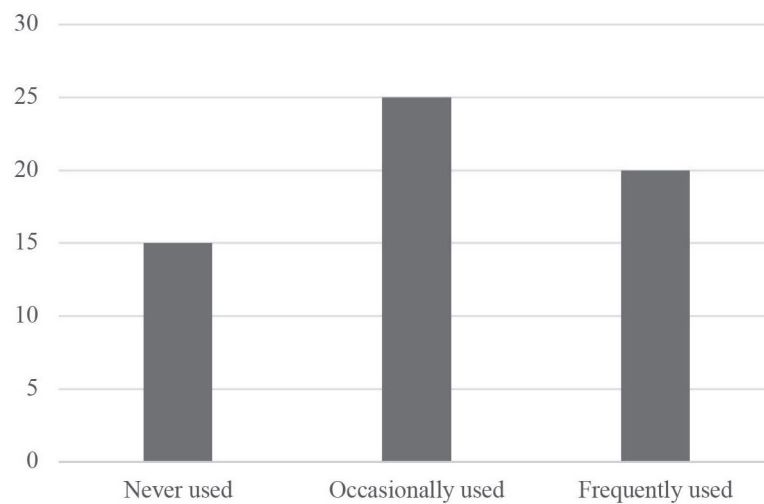
Emotional Response: Female users scored higher in emotional response (0.65) than male users (0.60), suggesting that women are more likely to experience emotional resonance from product design.



**Figure 1** Age distribution.



**Figure 2** Distribution of educational qualifications.



**Figure 3** Occupational Distribution.

Overall, female users have greater demands for functionality, comfort, and emotional response, while male users tend to prioritize functionality and usability.

According to Figure 6, significant differences in scores across dimensions were observed among different age groups:

**Functionality:** Users aged 18–25 scored the highest in functionality (0.90), with scores gradually decreasing to 0.78 for users over 51 years old. This indicates that younger users are more focused on the realization of product functionality.

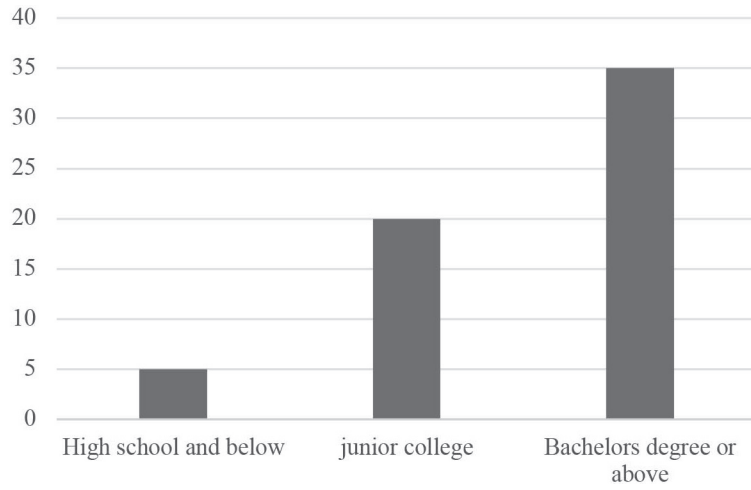


Figure 4 Frequency of use of health products.

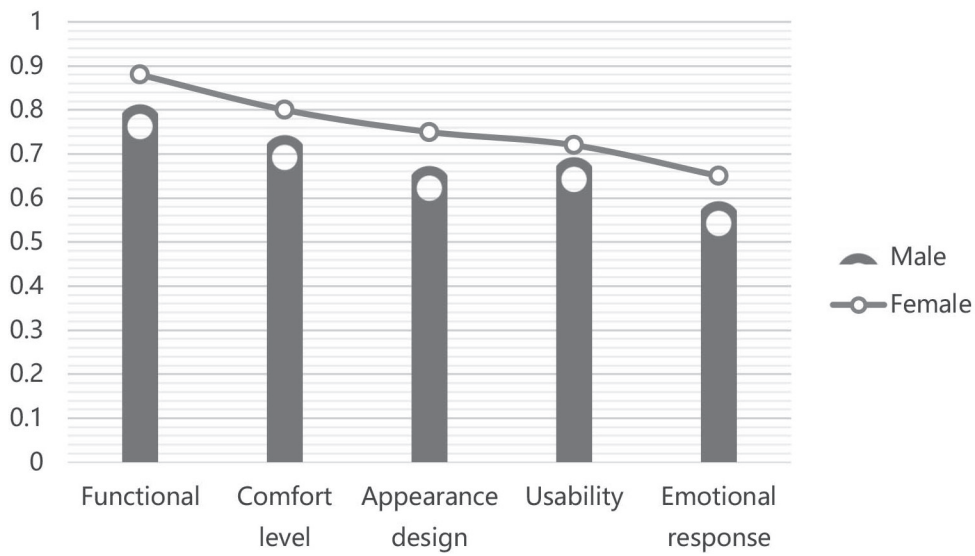


Figure 5 Fuzzy membership distribution across dimensions by user group.

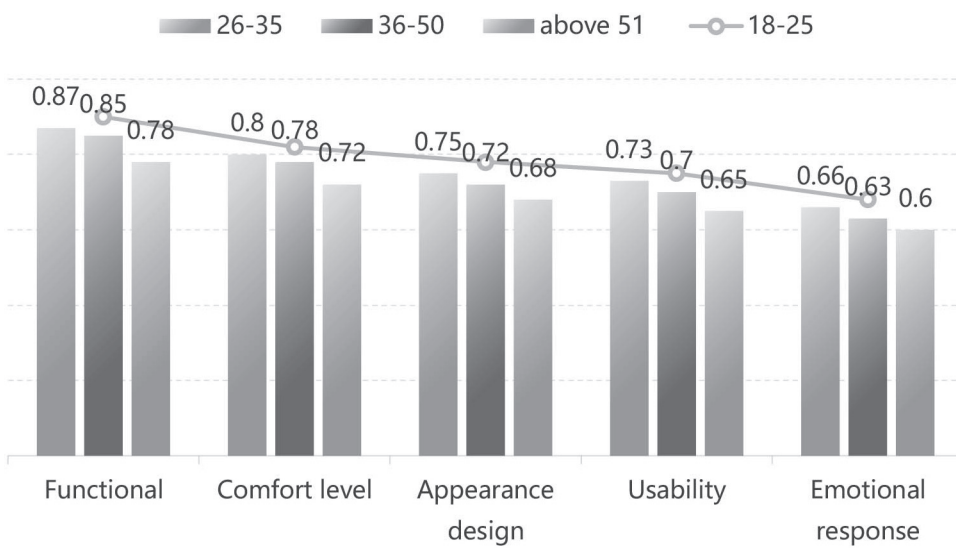


Figure 6 Fuzzy membership distribution across dimensions by age group.

**Table 3** Fuzzy rules for functional dimensions.

Dimension	Fuzzy Rules
Functionality	If massage intensity is moderate, and massage duration is long, then user experience is good.
Functionality	If massage intensity is high, and massage duration is short, then user experience is poor.
Functionality	If heating temperature is moderate, and heating time is long, then user experience is good.
Functionality	If heating temperature is high, and heating time is short, then user experience is poor.

Comfort: Users aged 18–25 and 26–35 scored 0.82 and 0.80 respectively in comfort, significantly higher than users over 51 years old (0.72), reflecting that younger users have a greater demand for comfort during use.

Appearance Design: Younger users (18–25 years old) scored the highest in appearance design (0.78), which may be related to their greater attention to the visual appeal of products.

Usability: Scores for usability were relatively balanced across all age groups, ranging from 0.70 to 0.75, indicating that usability is a fundamental requirement for all user groups.

Emotional Response: Younger users (18–25 years old) scored the highest in emotional response (0.68), while users over 51 scored the lowest (0.60), indicating that younger users are more sensitive to emotional experiences.

Younger users have higher demands for functionality, appearance design, and emotional response, while middle-aged and older users place greater emphasis on comfort and usability.

The data analysis reveals the following: Female and younger users show a stronger preference for functionality and appearance, reflecting their strong attention to product performance and visual appeal.

Male and older users prioritize comfort and usability, indicating that these groups are more inclined to prefer convenience and ease of use in their product experience.

In terms of emotional response, female and younger users scored higher, suggesting that these groups are more likely to derive emotional satisfaction from product design.

Based on these findings, it is recommended that products be designed with greater emotional and visual appeal for younger users, while optimizing comfort and usability for middle-aged and older users to better meet the personalized needs of different groups.

## 4.2 Optimization Method and Path Based on Fuzzy Algorithm

### 4.2.1 Fuzzy Inference and Experience Optimization Model

By blurring user needs, feedback and preferences, designers are better able to develop product optimization paths that are more aligned with users’ expectations. The fuzzy inference system is based on fuzzy logic, which enables the design scheme to better adapt to the diverse needs of users by dealing with uncertainty and fuzzy data.

#### (1) Fuzzy reasoning rule setting

Taking the functional dimension as an example, the set rules are shown in Table 3.

In addition, the remaining dimensions are configured using the same pattern of fuzzy rule settings to ensure consistency in the inference process.

#### (2) Membership function and fuzzy processing

In order to quantify user preferences and experiences, membership functions need to be defined for each key indicator (such as massage intensity, temperature, comfort, etc.). The membership function can help determine the extent to which an input value belongs to a certain fuzzy set, with values ranging between 0 and 1.

For example, for massage intensity, the membership function is defined as follows:

Low intensity: 0 (totally unsuitable) to 1 (fit)

Medium intensity: 0 to 1, adapted to different user preferences

High strength: 1 (perfect fit) to 0 (totally unsuitable)

#### (3) The fuzzy reasoning process

The fuzzy reasoning process comprises several steps:

Fuzzy set: convert the specific score that the user input into a fuzzy set. For example, the users rating of massage intensity can be converted to fuzzy values of low, medium and high intensity.

Apply fuzzy rule: reasoning about fuzzy input by the “If-then” rule. For example, if the massage is more intense and shorter in duration, it may result in a poor user experience.

Deblur: convert the reasoning results into specific output values, and the final output result is usually calculated by the center of gravity method, such as the optimized massage intensity or comfort score.

#### (4) Experience optimization model

The experience optimization model based on fuzzy inference comprehensively optimizes the multiple needs and preferences of users. For example, the design of appearance, massage function, comfort and other factors of the product can be blurred according to the users’ feedback, and the optimal range of each design parameter can be obtained through the inference model.

### 4.2.2 Optimization Path and Design Decision

In this study, the optimization path and design decision are based on the analysis results of user feedback and fuzzy inference model, ensuring that the product is optimized in multiple dimensions. First, the optimization goal is defined, and the optimization priority is established by identifying the key issues (such as massage function, heating temperature, etc.). Based on user preference analysis, design decisions are made, focusing on optimizing the most important functions in the user experience, such as providing multi-gear adjustable massage intensity and adjustable heating temperature.

During the optimization process, the team made specific design decisions, such as adjustments to the massage function,

**Table 4** Comparison of ratings before and after optimization.

Dimension	Pre-Optimization Score	Post-Optimization Score	Score Improvement (Post - Pre)
Functionality	3.2	4.5	1.3
Comfort	3.5	4.7	1.2
Appearance	3.8	4.6	0.8
Usability	3.6	4.8	1.2
Emotional Response	3.9	4.7	0.8

**Table 5** Comparison of user satisfaction before and after optimization.

Dimension	Pre-Optimization Satisfaction	Post-Optimization Satisfaction	Satisfaction Improvement (Post - Pre)
Functionality	3.1	4.6	1.5
Comfort	3.4	4.7	1.3
Appearance	3.8	4.6	0.8
Usability	3.6	4.8	1.2
Emotional Response	3.9	4.7	0.8

**Table 6** Comparison of user preferences before and after optimization.

Dimension	Pre-Optimization Preference	Post-Optimization Preference	Preference Improvement (Post - Pre)
Functionality	3.3	4.8	1.5
Comfort	3.5	4.7	1.2
Ease of Use	3.6	4.8	1.2
Appearance	3.7	4.6	0.9
Emotional Response	3.8	4.7	0.9

heating control and appearance design, to meet the user needs. After each optimization, new feedback was collected for evaluation, and the design was further modified according to the results to ensure continuous improvement.

The key to the success of this process is to ensure that every optimization decision in product design can effectively enhance the user experience and maintain the product's competitiveness by means of continuous user feedback and fuzzy reasoning models.

### 4.3 Optimization Effect Evaluation

In this study, the objective of the optimization effect evaluation was to measure the improvement of the user experience after product optimization. The evaluation was conducted using multiple dimensions, including user feedback, experience scoring, and functional testing, to verify the effectiveness of the optimization design. The following are the specific contents of the optimization effect evaluation.

(1) Optimize the comparison of user experience scores before and after

In order to understand the differences before and after optimization, the research team compared the user feedback scores for the design before and after optimization. The score covers the dimensions of functionality, comfort, appearance design, ease of use and so on. Table 4 is a score comparison table before and after optimization.

(2) Core function implementation and user feedback

By collecting new user feedback data, user satisfaction with each dimension of the product was compared and optimized. The results are shown in Table 5.

(3) Improvement of user preferences and experience

Through the analysis of user preferences, the optimized design better meets their needs. The specific improvements are shown in Table 6.

(4) Comprehensive evaluation and improvement direction

Based on the evaluation results, the optimized design was significantly improved in terms of functionality, comfort, and ease of use. Based on the specific user feedback, the research team identified the following improvement directions.

Users hope that the product provides more personalized adjustment options and adds time control function to meet different usage needs; users reported that the material texture and ergonomic design enhance the comfort, but some users want the design of the contact parts; users generally believe that the operation interface is simple and understandable and the button design is intuitive, but some users suggest adding the voice prompt function to further enhance the convenience of use; most users are satisfied with the color matching and overall shape of the product, while a few users suggest adding more color choices to adapt to different home styles. Based on this feedback, the team will focus on improving the product's personalized adjustment and material permeability to further enhance the overall user experience.

## 5. CONCLUSION AND OUTLOOK

### 5.1 Study Conclusion

Applying the fuzzy algorithm, this study systematically analyzed the design and user experience optimization of art health products, drawing the following conclusions.

The fuzzy algorithm shows strong adaptability when dealing with the uncertainty of user needs, providing effective support for the multi-dimensional design requirements. To optimize the function and appearance of the product, the fuzzy algorithm helps designers to accurately quantify the fuzzy needs of users, thereby more closely aligning the design scheme with the actual needs of users. By optimizing the design, user satisfaction with functionality, comfort and ease of use has significantly improved. The analysis of user feedback shows that improvements such as personalized adjustment and comfortable materials can further enhance the product experience, especially given its great potential to meet the personalized needs of different users.

This study verifies the effectiveness and practicability of using the fuzzy algorithm in the design of art health products, and provides important theoretical basis and practical guidance for the improved design of related products. This result not only improves the market competitiveness of the product, but also indicates the direction for the future product development.

## 5.2 Outlook

In the future, with the continuous improvement of users demand for personalized and high-quality experience, the application prospect of fuzzy algorithm in the design of art health products is broad. Further research can combine artificial intelligence and big data analysis technology to capture accurately any changes in user needs and provide real-time optimization solutions for product design. In addition, the deep mining and analysis of multi-dimensional user data will help to achieve a more personalized functional design and improve the diversification of user experience. With the progress of technology, the application of fuzzy algorithms will be more advanced, which is expected to promote the innovation and development of art health products.

## COMPETING INTERESTS

No conflict of interest exists in the submission of this manuscript.

## DATA AVAILABILITY STATEMENTS

The original contributions presented in the study are included in the article; further inquiries can be directed to the corresponding author.

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