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Applying the Methods of AHP and TOPSIS-IPA to Approach the Factors of Influencing Consumer Preferences for Corrective Eyewear Design

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Abstract:

The design of corrective glasses directly affects the willingness of people who need vision correction to wear glasses. In particular, wearing glasses will change one's appearance and attractiveness. You might also worry that wearing glasses could make others think you have a physical or mental disability. As times change, the factors that need attention in design will also change. This study explores key factors underlying consumer preferences for corrective eyewear design under changing lifestyles (technology, aging population, and green consumption). Unlike the traditional 5-point equal interval semantic questionnaire, this study uses an equal-proportion golden ratio scale semantic questionnaire. Through document analysis and the Analytic Hierarchy Process (AHP), the relative weights of importance among the key factors of each item were determined. Simultaneously, the Importance Performance Analysis (IPA) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) were used to obtain the preference order of corrective frame glasses design preference factors. This study hopes that through the appropriate design of corrective glasses, more people will be willing to wear glasses to improve their visual health and achieve good quality of life. The results obtained can also be used as a reference for corrective eyewear design research by eyewear designers and practitioners.

Keywords:

Corrective glasses

Analytical Hierarchy Process (AHP)

Golden ratio scale semantics

Important Performance Analysis (IPA)

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

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1. Introduction

Vision is the most important of the five senses and is an important organ for the transmission of information through non-verbal means. It plays a very important role in face-to-face communication and social interaction. Although wearing glasses can alter one's appearance, individuals have varied subjective perceptions of how attractive or unattractive this change may be. According to the World Health Organization's "World Vision Report," 2.6 billion people worldwide have received correction for myopia, 1.8 billion for presbyopia, and at least 1 billion people still have unmet vision needs. Among them, 123.7 million have myopia and hyperopia, while 826 million have presbyopia. The report identifies three main reasons why some people do not use corrective glasses. First, they believe that wearing glasses will affect their appearance. Second, they fear that wearing glasses will make them appear disabled. Third, they are concerned that long-term use of glasses might worsen their vision [1].

Due to significant societal changes, including advancements in science, technology, and mass production, as well as the serious issue of an aging population and evolving eye usage habits, perceptions of beauty and quality have shifted. With the global trend towards aesthetic popularization, more residents in Taiwan are paying attention to the impact of beauty on individuals. If Taiwan can embrace and understand the value of local beauty and integrate culturally significant images into daily life and commercial applications, it could enhance the quality of life and aesthetic appreciation among its citizens. This would positively impact various aspects of society, including industrial aesthetics [2].

This study will survey the demand for corrective eyeglass frames to understand public design preferences amidst social changes. The focus is on Taiwan residents and includes various types of corrective glasses, such as those for myopia, hyperopia, astigmatism, and presbyopia. Instead of the isometric scale commonly used in AHP research, this study adopts the Fibonacci inheritance method and the golden ratio scale for evaluation. This approach aims to more accurately reflect aesthetic evaluations and recognized beauty standards. Additionally, the study will employ literature analysis, AHP, IPA, and TOPSIS to determine the preference order of factors influencing corrective eyeglass frame design. The results are expected to help designers create glasses that better align with the preferences of corrective frame users.

2. Literature discussion

Glasses have a history of 700 to 800 years. The exact origin of their earliest appearance is unknown, but the most widely accepted theory is that they originated with Italian church members. They needed a solution for reading difficulties and devised the idea of placing lenses into frames to address vision problems [3]. In the Middle Ages, glasses became a luxury item for aristocrats and wealthy people to show off their wealth and status. Myopia has become a serious issue in Taiwan in recent years, earning it the nickname "Kingdom of Glasses." Historically, during the early Qing Dynasty and the Japanese colonial period in Taiwan, glasses held not only medical significance but also served as a fashionable accessory symbolizing "civilization" and "exported goods" among celebrities and the gentry [4]. Since glasses can restore vision through correction, allowing people to see clearly and improve their quality of life, they have gradually become a widely used necessity in people's lives [5].

Following this are users' various needs, including functionality, comfort, and aesthetics. Conducting a thorough demand analysis is crucial for product success. In addition to understanding user functions, pursuing uniqueness in design is essential to avoid creating a product that falls short of users' expectations and feelings [6]. Sometimes, users may struggle to clearly articulate their needs and can only perceive the gap between their feelings and expectations. Designers cannot fully understand this gap on their own. In product design, designers rely on their knowledge of materials, structure, manufacturing, and usage conditions to impart aesthetic value to the product. Designing glasses involves not only redefining and giving new meaning to their shape but also requires the designer's unique talent and creativity to interpret and transform abstract concepts into a concrete form using appropriate materials [7].

In recent years, due to an aging population and increasing societal expectations for inclusivity, there has been a growing acceptance of the Universal Design concept, which is intended to be accessible to everyone. According to data from the Ministry of the Interior, Taiwan's population began transitioning into an "aging society" in 1993. It is estimated that by 2060, Taiwan's elderly population will rise significantly, with a ratio of 39.27%, making it the second highest in the world. This rapid increase in the elderly population also means that vision issues among the elderly are becoming more pronounced [8].

Contemporary design not only focuses on environmental protection, ethics, and inclusive design but also emphasizes emotional design. There is increasing attention to the relationship between people and their environment, requiring designers to take on greater social and moral responsibilities. Design goals and methods must consider both social and ecological impacts. Design is viewed as a powerful tool for shaping the environment [9]. Japanese designer, Satoshi Nakagawa, added three key elements to the concept of universal design: "economical for long-term use," "good quality and pretty," and "harmless to human body and environment." These elements integrate universal design principles into contemporary design practices [10]. Therefore, this study employs Nakagawa's three universal design elements as the hierarchical structure for an expert questionnaire using AHP to determine the weight of preference factors. Additionally, it investigates Taiwan residents' expectations and satisfaction through a separate questionnaire. This questionnaire also gathers public opinions on the gap between expectations and satisfaction with the design of corrective eyeglass frames, providing a valuable reference for future related research.

3. Research design and methods

3.1. Document analysis

Document analysis involves conducting in-depth research by collecting and analyzing various literature to extract the information needed for specific research purposes or topics. When collecting literature, it is important to gather a comprehensive range of sources and then analyze and summarize them. Data sources for document analysis can include newspaper articles, internet webpages, government reports, corporate research, library collections, and master's or doctoral theses [11]. Document analysis generally involves four main steps: reading and organizing, description, classifying, and interpretation [11]. This study utilizes document analysis to incorporate Nakagawa's three universal design elements as factors for eyewear design preferences within the framework of the AHP.

3.2. Analytic Hierarchy Process (AHP)

AHP is a multi-criteria decision-making method that converts qualitative problems into quantitative analysis proposed by Thomas L. Saaty, a professor at the University of Pittsburgh in the United States in 1971. The characteristic is that complex decision-making systems can be constructed in a hierarchical form [12]. A comparison matrix is formed through dual evaluation of each factor for quantitative description, and then mathematical methods are used to calculate the relative weight of the elements at each level, and the relative weight of each element is obtained and sorted [12]. In terms of scale, AHP mostly adopts the 1 to 9 equidistant proportional scale proposed by Professor Saaty. However, an excessively large semantic range can easily lead to logical incoherence among respondents, which often fails to meet the consistency requirements of the judgment matrix, resulting in excessive differences in the weights of each factor. This study uses the golden ratio scale semantics to replace Saaty's 1 to 9 scale to make the weights of factors at the same level closer to coordination. The golden section has become a well-known aesthetic rule recognized since its inception and is widely used in music, painting, sculpture, architecture, and other art forms. The semantics of the golden ratio scale are also commonly used in research in other fields [13,14].

The meaning of the golden ratio scale to the ratio of adjacent semantic importance ratios is if the importance proportion of the meaning of adjacent factors W_1, W_2, W_1+W_2 satisfies the equal ratio semantics, that is, $\frac{W_1+W_2}{W_1}=\frac{W_1}{W_2}=\varphi$, because φ corresponds to the quadratic equation φ^2-φ-1=0, the correct solution φ is approximately 1.618, which is the golden ratio, and the 5-point golden ratio scale satisfies the Fibonacci sequence law, that is, $F_{n+2}=F_n+F_{n+1}$, $F_1=1$, $F_2=1.618$, as shown in **Table 1**. Unlike traditional 5-point equal-spaced semantic questionnaires, using the golden ratio to create an unequal-spaced semantic scale allows for distinguishing the relative importance of adjacent semantic levels. This approach highlights the weighted emphasis on the significance of various design aspects of corrective glasses.

Table 1. Golden ratio scale

Scale	Instruction
1	A1 and A2 are equally important
1.618	A1 is slightly more important than A2
2.618	A1 is more important than A2
4.236	A1 is much more important than A2
6.854	A1 is extremely important than A2

This study uses 10 experts in Taiwan as questionnaire analysis objects, and applies the AHP method to deal with decision-making problems. It is mainly divided into the following steps:

(1) Establish a hierarchical structure.

(2) Use the golden ratio scale to design a paired comparison questionnaire.

(3) Create a pairwise comparison matrix, $R=(r_{ij})_{n\times m}$.

(4) Calculate the weight vector M1 of each indicator factor.

M_i of which $M_i = \dfrac{W_i}{\sum_i^n W_i}$ $W_i = \sqrt[n]{\prod_{j=1}^{n} r_{ij}}$

$i = 1, 2, \cdots, n$; $j = 1, 2, \cdots, m$

(5) Test the consistency index (Consistency index, C.I. < 0.1) and consistency ratio (Consistency ratio, C.R. < 0.1) to detect whether there are inconsistencies in the decision-making analysis process, indicating that the calculated evaluation index weights are aggregated rationally.

(6) Integrate the relative weights of elements at each level to obtain the total priority vector of the overall level.

3.3. Establishment of evaluation indicators

"Following the document analysis, three additional criteria from Nakagawa's Universal Design were selected: "economical for long-term use," "good quality and pretty," and "harmless to the human body and the environment." These criteria constitute the first level of the AHP. The second level encompasses three aspects and includes a total of 10 items [15]. See **Figure 1** below.

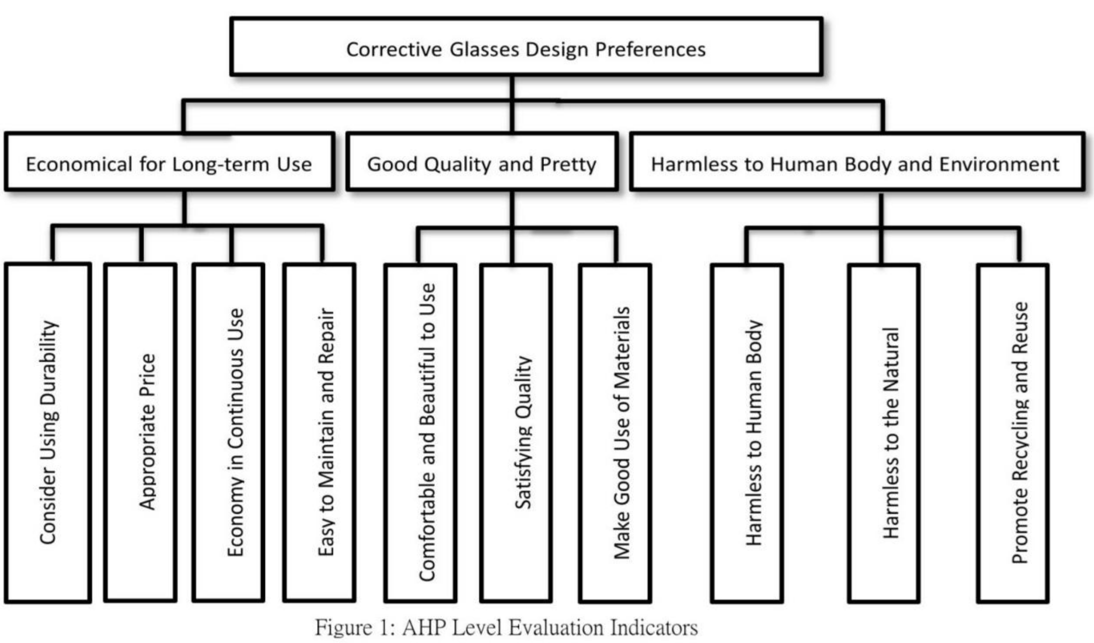

Figure 1. AHP level evaluation indicators

3.4. Important Performance Analysis (IPA)

The Important Performance Analysis (IPA) method, first proposed by Martilla and James in 1977, is used to understand how much customers value (expectations) and how satisfied they are with the performance of goods or services. IPA plots these two subjective measures—expectations and satisfaction—on a two-dimensional matrix, dividing them into four quadrants to determine priority areas for improvement [16]. Due to its simplicity, effectiveness, and ease of use, IPA helps management units allocate resources to enhance overall performance and has been widely adopted in marketing management decision-making [17]. This study uses an IPA questionnaire to investigate Taiwan residents' preferences, importance, and satisfaction with corrective eyeglass frames.

3.5. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

The TOPSIS method evaluates the relative merits of existing objects based on their proximity to an ideal goal (Ideal Solution). The optimal idealized goal is called the Positive Ideal Solution, and the worst idealized goal is called the Negative Ideal Solution. Euclidean distance is used to calculate the distance. The problem of multi-attribute decision-making often results in decision-makers being unable to make smooth decisions due to conflicts between attributes. To solve the problem of decision-making, many of them have been proposed one after another. Hwang and Yoon proposed this method in 1981, and its calculation steps are summarized as follows.

(1) Establish a standardized evaluation matrix, based on IPA and golden ratio scale semantics.

(2) Convert the semantic variables into a weight evaluation matrix, $v_{ij}=w_j r_{ij}$, where W_j is the weight of each preference factor AHP. Where $i=1,\ldots,n$, $j=1,\ldots,m$.

(3) Find the positive ideal solution, $A^+=(v^*_1,\ldots,v^*_m)$, $v_j^*=\max_i v_{ij}$ and the negative ideal solution $A^-=(v^-_1,\ldots,v^-_m)$, $v_j^*=\min_i v_{ij}$.

(4) Calculate the distance scale, that is, calculate the distance of each target to the positive ideal solution and the negative ideal solution. The distance scale can be calculated through Euclidean distance and the distance function, S_i is defined as

$$S_i^+=\sqrt{\sum_{j=1}^{m}(v_{ij}-v_j^*)^2},\quad S_i^-=\sqrt{\sum_{j=1}^{m}(v_{ij}-v_j^-)^2}.$$

(5) Arrange the priorities and calculate the closeness of the ideal solution CC_i, where $0\leq CC_i\leq 1$. When $CC_i=0$, it means that the target is the optimal target, and when $CC_i=1$, it means that the target is the worst target. In actual multi-objective decision-making, where

$$CC_i=\frac{S_i^+}{S_i^-+S_i^+}$$

TOPSIS and AHP are both Multi-Criteria Decision Making (MCDM) methods. Both are often used in selecting and evaluating plans. Decision-makers can evaluate plans under several evaluation criteria [18].

4. Data analysis and conclusion

4.1. AHP analysis results

Through literature review and inductive analysis, two levels of criteria were identified. The first level includes three major aspects: "economical for long-term use," "good quality and pretty," and "harmless to the human body and environment." The second level consists of 10 key factors: "consider using durability," "appropriate price," "economy in continuous use," "easy to maintain and repair," "comfortable and beautiful to use," "satisfying quality," "make good use of materials," "harmless to the human body," "harmless to the natural environment," and "promote recycling and reuse." As shown in **Table 1**, using a 5-point golden ratio scale, an expert questionnaire survey was conducted to evaluate the relative importance of these indicators. The Analytic Hierarchy Process (AHP) was used to calculate the weights of the three major aspects, as detailed in **Table 2**. The most valued aspect is "economical for long-term use," with a weight of 0.508, indicating that experts believe this factor is crucial for the successful design of corrective glasses. The second most important aspect is "good quality and pretty," with a weight of 0.325, while "harmless to human body and environment" is the least important, with a weight of 0.167. The consistency of this hierarchical structure, with consistency ratios both below 0.1, indicates that the consistency requirements are met.

Table 2. Weight and importance ranking of the three major factor aspects evaluation criteria

Factor Facet	Weights	Importance Ranking
Economical for long-term use	0.508	1
Good quality and aesthetic	0.325	2
Harmless to human body and environment	0.167	3

4.1.1. The factors of "economical for long-term use"

In **Table 3**, the ranking of its evaluation indicators is: consider using durability (0.406), appropriate price (0.302), economy in continuous use (0.172), easy to maintain and repair (0.120). It can be seen that the interviewed experts believe that "Consider Using Durability" is the most important evaluation criterion in terms of "Economical for Long-term Use". The consistency of this hierarchical architecture, both are less than 0.1, indicating that the consistency requirements are met.

Table 3. "Economical for long-term use" weights and importance ranking

Key charisma factors	Weights	Importance ranking
Consider using durability	0.406	1
Appropriate price	0.302	2
Economy in continuous use	0.172	3
Easy to maintain and repair	0.120	4

4.1.2. The factors of "good quality and pretty"

In **Table 4**, the ranking of its evaluation indicators is: comfortable and beautiful to use (0.545), satisfying quality (0.294), and make good use of materials (0.162). it shows that the interviewed experts believe that "comfortable and beautiful to use" is the most important evaluation criterion under the "good quality and pretty" aspect. The consistency of this hierarchical architecture, both are less than 0.1, indicating that the consistency requirements are met.

Table 4. "Good quality and pretty" weights and importance ranking

Key charisma factors	Weights	Importance ranking
Comfortable and Beautiful to Use	0.545	1
Satisfying quality	0.294	3
Make good use of materials	0.162	2

4.1.3. The factors of "harmless to human body and environment"

In **Table 5**, the ranking of its evaluation indicators is: harmless to the human body (0.496), harmless to the natural environment (0.333), promote recycling and reuse (0.171). It shows that the interviewed experts believe that "harmless to human body" is the most important evaluation criterion under the aspect of "harmless to human body and environment." The consistency of this hierarchical architecture, both are less than 0.1, indicating that the consistency requirements are met.

Table 5. "Harmless to hu an body and environment" weights and importance ranking

Key charisma factors	Weights	Importance ranking
Harmless to human body	0.496	1
Harmless to the natural environment	0.333	2
Promote recycling and reuse	0.171	3

4.1.4. The analysis of the overall weight of AHP

After the weights of all levels in **Table 2** to **Table 5** are generated, they are allocated according to the relative importance of the selection indicators at each level. The importance of the key charisma factors indicators at this level in the entire evaluation system is displayed, and the design preference for corrective frame glasses is generated. The overall weight of factors is summarized in **Table 6**.

Figure 2 shows the relative weight of each indicator of the design preference factors for corrective frame glasses. It can be seen from **Table 6** and **Figure 2** that among the 10 evaluation indicators, the top 5 indicators

Table 6. Summary of overall weights of corrective frame glasses design preference factors

Facets	Weights	Ranking	Key charisma factors indicators	Overall weights	Overall ranking
Economical for long-term use	0.508	1	Consider using durability	0.206	1
			Appropriate price	0.153	3
			Economy in continuous use	0.087	5
			Easy to maintain and repair	0.061	7
Good quality and pretty	0.325	2	Comfortable and beautiful to use	0.177	2
			Satisfying quality	0.095	4
			Make good use of materials	0.053	9
Harmless to human body and environment	0.167	3	Harmless to human body	0.083	6
			Harmless to the natural environment	0.056	8
			Promote recycling and reuse	0.029	10

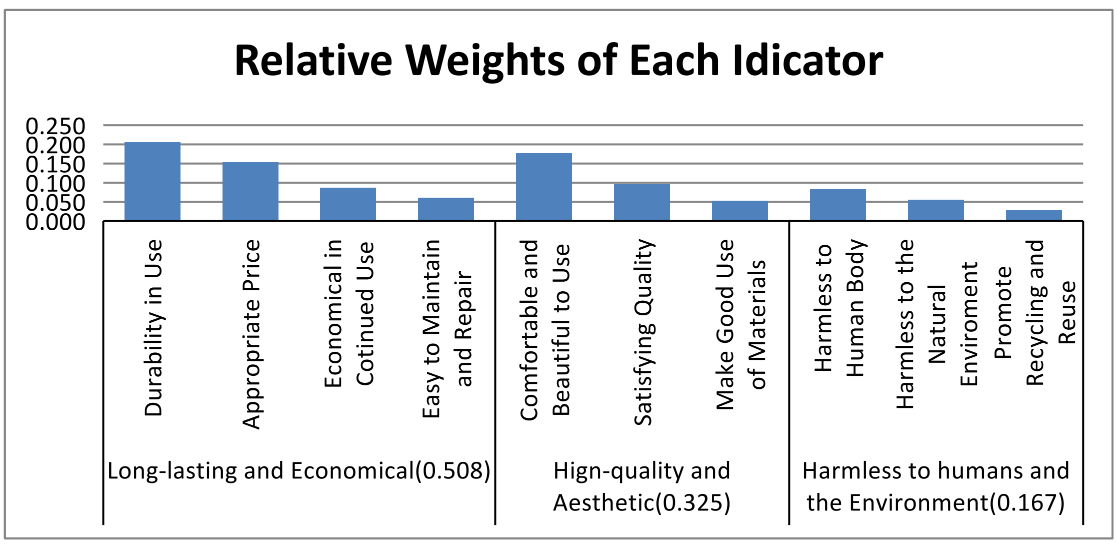

Figure 2. Corrective frame glasses design preference application indicators

that are most valued are, in order: consider using durability, comfortable and beautiful to use, appropriate price, satisfying quality, and economy in continuous use.

4.2. TOPSIS-IPA analysis results

There were 379 valid IPA questionnaires recovered. This study used Statistical Package for the Social Sciences (SPSS.17) statistical software to conduct reliability analysis. After sorting the questionnaires, the Cronbach's Alpha value of the importance questionnaire was 0.839, and the Cronbach's Alpha value of the satisfaction questionnaire was 0.917. Both are greater than 0.7, which is a credible level. The evaluation matrix of the importance and satisfaction value of IPA, weighted by the preference factor AHP weight in **Table 6**, is shown in **Table 7**.

From **Table 8**, we can know the positive ideal solution A^+=(1.106,0.939) and the negative ideal solution A^-=(0.136,0.118) based on the importance and satisfaction values.

As mentioned in section 3.5, the coefficients close to the negative ideal solution can be obtained as shown in **Table 9.**

Table 7. Evaluation matrix (v_{ij})

Factors	Importance	Satisfaction
Consider using durability	1.106	0.939
Appropriate price	0.832	0.671
Economy in continuous use	0.455	0.394
Easy to maintain and repair	0.336	0.295
Comfortable and beautiful to use	0.987	0.873
Satisfying quality	0.548	0.462
Make good use of materials	0.251	0.228
Harmless to human body	0.502	0.421
Harmless to the natural environment	0.297	0.254
Promote recycling and reuse	0.136	0.118

Table 8. Distance from preference factors to positive ideal solution and negative ideal solution

Factors	Distance from positive ideal solution	Distance from negative ideal solution
Consider using durability	0.000	1.271
Appropriate price	0.383	0.889
Economy in continuous use	0.849	0.422
Easy to maintain and repair	1.004	0.267
Comfortable and beautiful to use	0.136	1.138
Satisfying quality	0.734	0.537
Make good use of materials	1.112	0.159
Harmless to human body	0.796	0.475
Harmless to the natural environment	1.060	0.211
Promote recycling and reuse	1.271	0.000

From **Table 9**, after calculating the distance of each item factor to the positive ideal solution and the negative ideal solution, the close coefficient is obtained. It can be seen that the ranking of the "corrective frame glasses design preference" factor is:

(1) Consider using durability
(2) Comfortable and beautiful to use
(3) Appropriate price
(4) Satisfying quality
(5) Harmless to human body
(6) Economy in continuous use
(7) Easy to maintain and repair
(8) Harmless to the natural environment
(9) Make good use of materials
(10) Promote recycling and reuse

Table 9. Closeness to the positive ideal solution

Factors	Proximity coefficient	Ranking
Consider using durability	0.000	1
Appropriate price	0.301	3
Economy in continuous use	0.668	6
Easy to maintain and repair	0.790	7
Comfortable and beautiful to use	0.107	2
Satisfying quality	0.578	4
Make good use of materials	0.875	9
Harmless to human body	0.626	5
Harmless to the natural environment	0.834	8
Promote recycling and reuse	1.000	10

5. Conclusion

Based on the above analysis results, the order of output design factor evaluation can be provided for designers to incorporate into design reference and research. In this study, the three items: "economical for long-term use," "good quality and pretty," and "harmless to human body and environment" were selected as the main attribute facets through literature review. Then the 10-item factors: "consider using durability," "appropriate price," "economy in continuous use," "easy to maintain and repair," "comfortable and beautiful to use," "satisfying quality," "make good use of materials," "harmless to human body," "harmless to the natural environment," and "promote recycling and reuse" are calculated using the hierarchical analysis method, given appropriate weights, and break away from the traditional equal-distance interval evaluation model, using the golden ratio scale semantics, that is, the equal ratio aesthetic scale semantics, as an evaluation scale. After distributing the IPA questionnaire on the importance and satisfaction of Taiwan residents' preference factors for the design of corrective frame glasses, the matrix sequence was obtained after sorting and analysis and then sorted using TOPSIS to obtain the priority order of the design preference factors for corrective frame glasses. The results of this study also show that the public pays more attention to durability, comfort and appearance, appropriate price, and satisfactory quality.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Noncommunicable Diseases, Rehabilitation and Disability (NCD), 2019, World Report on Vision. World Health Organization, viewed March 27, 2024. https://www.who.int/publications/i/item/9789241516570

[2] Chang YH, Jiang JS, Lin MM, 2023, Applying the Methods of EGM and AHP to Approach the Preference Factors of Penmanship Seal Carving Imagery. Advances in Higher Education, 7(25): 4–12.

[3] Ho SM, 2014, Breaking Through Visual Boundaries in Eyewear Design. Oriental Daily, viewed March 27, 2014. https://orientaldaily.on.cc/cnt/lifestyle/20140327/mobile/odn-20140327-

[4] Zhang YY, 2021, Wearing Glasses in Taiwan: Not Just for Nearsightedness, But a Trendy Fashion Accessory. National Museum of Taiwan History, published March 25, 2021. https://collections.nmth.gov.tw/article.aspx?a=240

[5] Liu Q, Han X, Liao X, 2021, Exploration on the New Development Model of "Internet + Glasses" Industry in the New Era. Economic Research Guide, 2021 (36): 4.

[6] Gause DC, Weinberg G, 1989, Exploring Requirements: Quality Before Design Paperback. Dorset House Publishing, New York.

[7] Peng G, Yan Y, 2010, Exploring Design Principles for Eyeglasses Attributes Suitable for Various Age Groups. Journal of Studies, 24(1): 17.

[8] Wang L, 2004, International Comparative Analysis of the Trend and Causes of the Aging in China. Population and economy, 2004(1): 6.

[9] Zhang Z, 2024, On the Material Power in the Giono Ecological Writing. French Countries and Regional Studies, 2024(2).

[10] Wu K, 2012, The Meaning and Development of Universal Design. Journal of the Taiwan Institute of Architects, 2021: 14–17.

[11] Neuman LW, 2000, Social Research Methods: Qualitative and Quantitative Approaches (Translated by Chu Jou-Ruo). Yang Chih Publishing Co., Taipei.

[12] Saaty TL, 1980, The Analytic Hierarchy Process. McGraw-Hill, New York.

[13] Liu Y, 2005, Exploration on the Beauty of the Golden Proportion Based on the Product Form. Decor, 2005,(11): 92.

[14] Kuo CC, Jiang JS, Lin MM, 2023, To Approach the Aesthetic Preference of Taiwan Landscape Painting by the Methods of EGM and the Continuous Type of Fuzzy Kano Model. Journal of Contemporary Educational Research, 7(12): 268–278.

[15] Nakagawa S, 2006, A Textbook on Universal Design (Revised Edition, Translated by Zhang Xuqing). Longxi, New Taipei City.

[16] Martilla JA, James JC, 1977, Important-Performance Analysis. Marketing. 197741(1): 77–79. https://doi.org/10.2307/1250495

[17] Chu CH, 2015, Decision-Making for Resource Allocation to Enhance Overall Service Performance (Unpublished Manuscript). Research Project Report Supported by the Ministry of Science and Technology, Ministry of Science and Technology.

[18] Yu H, Guo M, 2020, Heterogeneous Wireless Network Selection Method Based on Intuitive Fuzzy Number and TOPSIS, patent, CN110944349A, published March 31, 2020.