Application of Visual Design Based on Clustering Algorithm in Sustainable Development of Green Ecology

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Abstract At this stage, due to unreasonable exploitation of natural resources and uncontrolled use of resources, environmental pollution, ecological damage and resource shortage have become increasingly prominent, which has damaged the environment for human survival and significantly affected the sustainability of human social and economic development. The sustainable development of green ecology is a new concept of development that takes the harmonious relationship between man and nature as the thought, and the realization of sustainable ecological environment protection and sustainable economic development as the goal. It is of positive significance for achieving the coordination and unity of human society and the natural environment, and achieving the sustainability of high-quality development of human society and economy. Therefore, this paper studied the sustainable development of green ecology, and analyzed the significance of clustering algorithm for visual image design. This paper also put forward the suggestion of using visual design works to promote ecological environment protection and governance, enterprise green ecological culture, and public green ecological consumption concept, and then studied the demand and effect of visual design application. The research showed that the cultivation level of green ecological culture of enterprises still needs to be improved, and the public's consumption concept still needs to change to green ecology. After watching the visual design works containing the green ecological concept, 62 respondents were willing to wholeheartedly practice the green ecological consumption concept, accounting for 41.33%. Visual design can play a certain role in the sustainable development of green ecology.

Index Terms Green Ecological Sustainable Development, Visual Design, Clustering Algorithm, Enterprise Green Ecological Culture

I. Introduction

The problems of environmental pollution such as air pollution and water pollution, ecological destruction such as water and soil loss, and resource shortage have gradually attracted people's attention. People have to reflect on the consequences of disordered development on the natural environment, and explore the sustainable development of green ecology. The realization of a sustainable green ecological development mode can greatly reduce the damage to the natural environment caused by human activities, and also help promote the high-quality and quantitative sustainable development of the economy. Based on this, this paper explores the application of visual design in the sustainable development of green ecology in order to promote the sustainable development of green ecology, hoping to provide valuable reference for related research.

Many scholars have studied the theme of green ecological sustainable development. Struik Paul C discussed the significance of agricultural ecological intensification for achieving sustainable development of agricultural green ecology [1]. Mikhno Inesa summarized the effective indicators and means that affect the level of ecological and economic development, and analyzed the role of green economy in the sustainable development of industrial production [2]. Ahmed Zahoor analyzed the impact of environmental laws and regulations on natural ecological sustainability and economic ecological sustainability [3]. Kasztelan Armand studied the relationship between green growth, green economy and sustainable development, and analyzed the purpose of the three "green" concepts to play a role at the same time [4]. Zheng Hua proposed a sustainable agricultural production ecological development strategy, which provides a reference for the study of agricultural ecological development strategy [5]. Vorosmarty Charles J analyzed the importance of achieving sustainable water security and summarized the measures to achieve sustainable water security [6]. Marco-Fondevila Miguel studied the determinants and empirical interrelationships between accountability standards and environmental enthusiasm in comprehensive companies, and proved that corporate social responsibility and corporate sustainable development capability have a positive correlation [7]. Gentry Rebecca R used the ecological perspective to deeply understand the interaction between offshore aquaculture and the surrounding environment on a series of spatial scales, so as to realize and promote

the sustainable development of aquaculture [8]. Sheldon Roger A discussed the application of the two indicators, E factor and atomic economy, in measuring the sustainability of the manufacturing process of drugs and other fine chemicals, and discussed the sustainable development of the production of bio based chemicals [9]. All the above scholars have carried out research on the sustainable development of green ecology and put forward valuable suggestions.

Many scholars have participated in the research work on visual design. Guo Shengneng analyzed the professional attribute and social significance of visual communication design, elaborated the design principles of natural ecological environment protection publicity sculpture, and explained the design methods of natural ecological environment protection sculpture under the guidance of visual communication concept [10]. Liu Lixue discussed the method to improve the quality of wildlife protection publicity information based on visual design theory, and analyzed the problems and solutions in the production and promotion of visual design works from the perspective of visual design [11]. Xu Zhen discussed the visual design strategy combined with the concept of low-carbon environmental protection, and analyzed the development trend of visual design combined with the concept of low-carbon environmental protection [12]. Hao He studied the visual design method of ecotourism map and specifically analyzed the application of visual communication elements such as text, image and color [13]. From the research of the above scholars, it can be seen that visual design can play a role in environmental and ecological protection. Based on this, this paper discusses the promotion role of visual design in the sustainable development of green ecology.

This paper puts forward the development strategies of visual design, such as in-depth study of dynamic visual information, adhering to the concept of humanized design, and combining practice with creation. It also proposes the implementation strategies of green ecological sustainable development, such as promoting the development of green industries, cultivating green culture, and cultivating the sense of social responsibility for green ecology of enterprises. Moreover, the effect of visual design application is analyzed in the paper.

II. Problems and Development Strategies in Visual Design

Visual design is all the design activities aimed at human visual senses. Visual design not only pays attention to the visual feelings of the audience, but also pays attention to the visual feelings of the designers themselves.

(1)Problems in visual design

The problems in visual design include the following aspects, as shown in Figure 1, specifically: the level of theoretical foundation to be improved, the innovative ability of visual design to be enhanced, the problem of homogeneity, the negative impact of public aesthetics, and the acceptance of works that do not meet expectations.

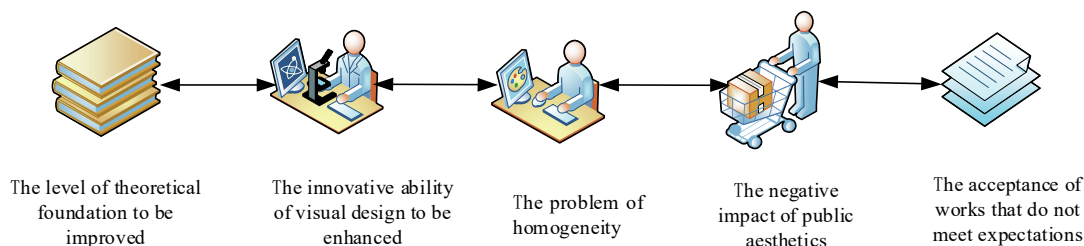| The level of theoretical foundation to be improved | The innovative ability of visual design to be enhanced | The problem of homogeneity | The negative impact of public aesthetics | The acceptance of works that do not meet expectations |

Figure 1: Problems in visual design

1) The level of theoretical foundation to be improved

Traditional visual design mostly takes static visual elements as the creation content and paper as the carrier. With the development of modern technology, a lot of visual information that can be received by human visual senses appears in digital form, and the types and forms of visual information are constantly enriched. In this case, some old visual theories cannot solve the emerging visual design problems, and the traditional visual design methods cannot meet the needs of visual design practice, nor can they play a role in realizing visual interactive design.

2) The innovative ability of visual design to be enhanced

At this stage, the visual innovation ability of some designers is still not high enough, and the main influencing factors are as follows. The contradiction between efficiency and quality: The demand for visual design is increasing, but the time and energy of designers are limited. Therefore, in the face of a large number of visual design needs, designers can only sacrifice the quality of design works and complete a large number of visual design works in a short time according to a fixed process. This fixed process and this way can hardly enable designers to display their creative talents. Unequal risk between payment and income: Digital visual design works are at risk of being

pirated, and designers face the risk of investing huge amounts of time and energy without getting a return. The contradiction between the continuous improvement of creative requirements and the limited level of designers: The audience's creative requirements for visual design continue to improve, but the designer's knowledge reserves and life experience are limited.

1) Serious homogeneity flooding

Although the development of modern information technology provides a more convenient, broader and richer stage for visual design, modern information technology also encourages disordered visual design imitation behavior. In the Internet environment, because designers can quickly access a large number of visual information and visual work resources, they are reluctant to actively think and innovate in visual design. Some designers and businesses may even copy a large number of existing visual information and visual work resources, rather than actively mining the artistic means and ideological connotation existing in these information and resources, which makes the visual design works homogeneous.

2) The negative impact of public aesthetics

For economic purposes, businesses often publicize the visual design works with strong color and strong visual sense offline and online. Although these visual works have a strong visual impact, they are full of a large number of vulgar and low interest visual design elements and thoughts and feelings. This situation also has an impact on the aesthetic level and preference of the public. Some people only pay attention to the external performance of visual design works, and do not pay attention to the artistic technique, spiritual connotation, innovation and individuality contained in the works. The designers may only sacrifice the internal quality of visual design works to meet the needs of the public aesthetic.

3) The acceptance of works that do not meet expectations

The acceptance of works is not only related to the creativity of design works, but also affected by the audience's hobbies. If a designer does not investigate the preferences of the audience in visual design, and only makes visual creation based on his own subjective intention, no matter how highly the experts evaluate the visual design works, the works he creates may not be accepted by the public.

(2) Development strategies of visual design

The development strategy of visual design includes in-depth research on dynamic visual information, strengthening innovation ability, promoting the development of visual design by using technical means, adhering to the concept of humanized design, and combining practice to create, as shown in Figure 2.

In-depth research on dynamic visual information

Combining practice to create

Strategies

Strengthening innovation ability

Adhering to the concept of humanized design

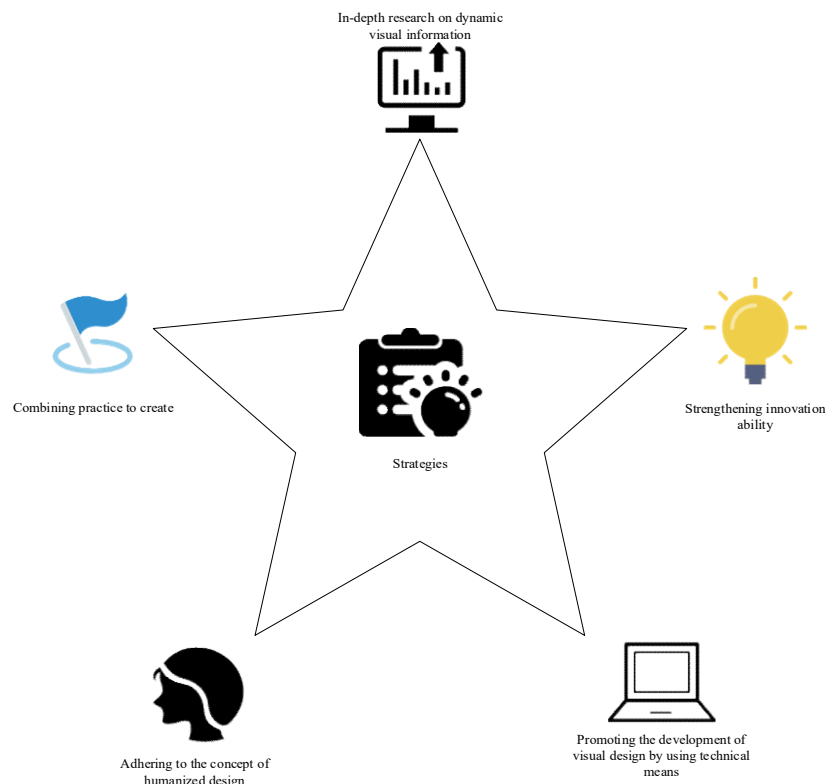Promoting the development of visual design by using technical means

Figure 2: Development strategies of visual design

1) In-depth research on dynamic visual information

The low basic level of visual design theory is mainly reflected in the dynamic visual information, so visual designers should strengthen the research on dynamic visual information, and gradually improve and optimize the visual design theory. After the dynamic visual information design theory is improved, designers can organically combine static visual information with dynamic visual information to improve the visual design effect.

2) Strengthening innovation ability

Visual designers should cultivate the habit of continuous learning, improve the efficiency of learning related knowledge, and promote the increase of their own knowledge reserves to provide support for visual design innovation. Visual designers can carry out visual design activities in the form of group cooperation, and stimulate designers' creative inspiration of visual design through the communication and discussion of ideas among group members.

3) Promoting the development of visual design by means of technology

Technology is an important driving force to promote visual design to a higher level, mainly in the following aspects. First, the breakthrough of material technology provides a richer carrier for the performance medium of visual design, which is helpful to improve the visual communication effect. Second, the progress of communication technology provides convenient tools and a good environment for visual design creation. Designers can obtain more abundant creative resources and have a broader communication platform. Third, the development of cutting-edge science and technology is conducive to promoting the development of visual design. For example, artificial intelligence can assist designers to create, which can not only improve the design efficiency, but also help improve the rationality and objectivity of visual creation.

4) Adhering to the concept of humanized design

Visual design should respect people's feelings and embodiment, and emphasize that the objects of visual design works are around people. Therefore, designers should pay attention to the interaction between the works and the audience, summarize the feeling rules of human visual organs, and pay attention to the aesthetic preferences and needs of the audience.

5) Combining practice to create

Before visual design, designers should fully investigate the visual preference of the audience and fully understand the visual symbols contained in regional culture and national culture. At the beginning of visual design, the designer should invite the audience to evaluate in addition to the expert evaluation method, so as to understand the commonness of the audience's visual and psychological feelings, and optimize and improve the visual design works. However, it is worth noting that the visual and psychological feelings fed back by the audience may be different from what the designer expected, which requires the designer to make reasonable choices.

III. Visual Image Design Based on Clustering Algorithm

In this paper, K-means clustering algorithm is used to study the image segmentation problem, so as to provide support for the creation of visual design works. The specific process of the algorithm is:

The sample set of visual design elements is set as T, and the sample set of visual design elements is divided into several clusters. Then there is Formula (1):

$$T = \{a_1, a_2, ..., a_m\} \tag{1}$$

The average clustering value is calculated as Formula (2):

$$u_p = \frac{1}{M_p} \sum_{a \in v_p} a \tag{2}$$

In Formula (2), a is the sample value of the visual design element.

The total error of visual design element sample set is calculated:

$$w_f = \sum_{p=1}^{c} \sum_{a \in v_p} \left\| a - u_p \right\|^2 \tag{3}$$

Any a is selected from the sample set. If M_p is 1, a is selected again; if not, the distance between the sample and the cluster mean should be calculated:

$$e_q = \begin{cases} \dfrac{M_q}{M_q + 1} \left\| a - u_q \right\|^2 & p \neq q \\ \dfrac{M_q}{M_q - 1} \left\| a - u_p \right\|^2 & p = q \end{cases} \tag{4}$$

If there is Formula (5),

$$k = {}^{\arg\min}{}_q e_q, 1 \le q \le c \tag{5}$$

then a needs to be moved from υ_p to υ_k.

The mean values of υ_p and υ_k are recalculated. If the error does not change after iteration, it is ended; otherwise, a is continuously selected.

IV. Implementation Strategies of Green Ecological Sustainable Development

The realization strategies of sustainable development of green ecology include promoting the development of green industries, cultivating enterprises' sense of green ecological social responsibility, giving play to the guiding and publicity role of the demonstration area, strengthening the ecological environment governance and publicity, and cultivating green culture, as shown in Figure 3.

Figure 3: Realization strategies of sustainable development of green ecology

(1) Promoting the development of green industry

The green development mode helps to improve the long-term economic benefits of enterprises, and the green ecological development of enterprises is also an important link to achieve sustainable green ecological development [14]. Based on the analysis from the perspective of science and technology, improving the technological innovation capability of the industry is an effective path and driving force to achieve green development of the industry. However, due to the risk of scientific and technological innovation activities, the enterprise's scientific and technological investment is faced with the risk of total loss, and it is difficult to effectively carry out innovation activities relying on the enterprise's own strength. Based on this, in addition to the scientific and technological innovation required by the green industry itself, the government, financial institutions and other entities should actively support the scientific and technological innovation of the green industry. The government plays a leading and guiding role in the sustainable development of green ecology. They should follow the principles of green development and ecological development to develop green industries, give policy support to green industries and financial subsidies and tax preferences to green enterprises, and optimize the admission process and approval process of green enterprises, so as to create a good development environment for green industries. Financial institutions can provide more preferential loan support for green industries, which is conducive to

lowering the threshold of green industry access and providing financial support for traditional enterprises to carry out green ecological transformation, thus ensuring the stability of enterprise capital chain.

(2) Cultivating enterprises' sense of green ecological social responsibility

The following aspects can be used to cultivate enterprises' green ecological social responsibility. Recognizing the importance of corporate green ecological social responsibility: The government should change the traditional concept of political achievements, and recognize the significance of corporate green ecological social responsibility for ecological protection and economic sustainability. From a long-term perspective, fulfilling the green ecological responsibility is more positive for enterprises. When choosing commodities, people tend to choose the products of enterprises that are willing to bear and dare to bear social responsibility, as well as those that bear green ecological responsibility. Guiding public opinion: Visual design methods can be used to publicize the enterprises undertaking green ecological responsibility, so that the enterprises can have a good corporate image. Moreover, the enterprises that pollute the environment can be publicized by using visual design methods and through television, the Internet and other media, so that they can actively carry out the sustainable transformation of green ecology.

(3) Giving play to the guidance and publicity role of the demonstration area

The government should establish green industry demonstration areas to make the green sustainable theory be applied in practice. Through the establishment of demonstration areas, people can understand the progressiveness and actual effect of the green ecological sustainable development mode. Publicizing the development of the demonstration area is conducive to guiding and promoting enterprises to actively carry out green ecological sustainable development activities.

(4) Strengthening ecological environment governance and publicity

Supervision: The government should do a good job in ecological environment supervision, especially strengthening the work of grass-roots ecological environment monitoring personnel. The government can use the Internet of Things, artificial intelligence, wireless communication and other modern technologies to establish a real-time monitoring system to protect the ecological environment from damage. Economy: The government should increase financial investment in environmental pollution and prevention, and guide the development of green financial derivatives, thereby providing economic support for the operation of green industries. Law: The legislature should formulate scientific laws and regulations according to the ecological environment governance situation, the actual social economic level and the future governance expectations, and the law enforcement agencies should increase penalties for ecological environment pollution and damage on the basis of standardized law enforcement. Publicity: Visual design works with the theme of ecological protection can be used to publicize the significance and role of ecological environment for people's survival and sustainable development, and publicize the necessity and results of ecological environment governance, enabling people to support the green ecological sustainable development mode from the bottom of their hearts.

(5) Cultivating green culture

The cultivation of green culture can be started from the two aspects of enterprises and the whole society. From the perspective of enterprises, the managers should actively cultivate the green ecological concept of employees, so that every link between production and sales of enterprises reflects the green ecological idea. At the production end of an enterprise, the purchase of raw materials, the purchase, use and maintenance of production equipment, and the consumption of materials and energy should be green and ecological. In daily management of enterprises, the managers and employees of enterprises should adhere to the concept of green ecology. The use of computers, printers, multimedia equipment and other office equipment, as well as the use of paper and other office supplies, should maintain the concept of green ecology. At the sales end of the enterprise, the packaging of the products produced by the enterprise and the advertising activities of the enterprise should reflect the green culture. Enterprise managers can use visual design works to cultivate green culture, integrate green culture ideas into visual design works, and use the artistry and visual impact of visual design works to enable employees to really think about the connotation of green ecological ideas, so that employees can truly recognize green ecological ideas and identify with the concept and path of sustainable development of green ecology. To cultivate green culture, enterprise managers can also establish green culture indicators [15].

From the perspective of the whole society, the cultivation of green culture is mainly reflected in the following aspects: Strengthening the green ecological culture education of students makes students can cultivate green consumption awareness and the concept of sustainable development. Schools can carry out education through visual design works to enhance the visual and psychological feelings of students, thereby promoting the profundity and image of green culture education. To guide the public to green consumption, the government can use the public service advertising visual design to spread the green consumption values to the public, guide the public to green life, make the public develop a good habit of green travel and consumption, and make the public realize the significance of green consumption for the sustainable development of green ecology. They can also subsidize the

green sustainable consumption behavior of the public. For example, the government can subsidize green products in the form of coupons and reduce green product taxes. Both governments and enterprises can use advertising visual design to convey green product subsidy information to the public.

V. Demand and Effect of Visual Design Application

This paper first investigated the cultivation level of green ecological culture of five enterprises in city Z in the form of telephone interview, and conducted three telephone interviews. Each telephone interview selected five employees from each enterprise (that is, 25 employees were selected for each telephone interview). Then, this paper conducted three field surveys in different blocks of city Z, each of which selected 50 respondents, investigated the public's green ecological consumption concept, and displayed the public service advertising visual design works containing green ecological concept to observe their feelings. The basic characteristics of the telephone interviewees are shown in Table 1.

Table 1: Basic characteristics of telephone interview subjects

	1	2	3
Mean age	36.87	38.59	37.72
Male employees	18	20	17
Female employees	7	5	8
Average years of service	3.54	3.74	5.41

As shown in Table 1, in the first telephone interview, the average age of the interviewees was 36.87, the number of male employees and female employees was 18 and 7 respectively, and the average length of service of the interviewees was 3.54. In the second telephone interview, the average age of the interviewees was 38.59, with 20 male employees and 5 female employees, and the average working years of the interviewees was 3.74. In the third telephone interview, the average age of the interviewees was 37.72, with 17 male employees and 8 female employees, respectively. The average working years of the interviewees were 5.41.

The basic characteristics of the field survey objects are shown in Table 2.

Table 2: Basic characteristics of field survey objects

	1	2	3
Mean age	45.26	42.36	41.08
Male member	37	41	34
Female member	13	9	16

As shown in Table 2, in the first survey, the average age of the respondents was 45.26, with 37 male members and 13 female members. In the second survey, the average age of the respondents was 42.36. The number of male members was 41 and the number of female members was 9. In the third survey, the average age of the respondents was 41.08, with 34 male members and 16 female members.

(1) Level of green ecological culture cultivation of enterprises

The employees' views on the level of enterprise green ecological culture cultivation during each telephone interview were recorded, as shown in Figure 4 for details.
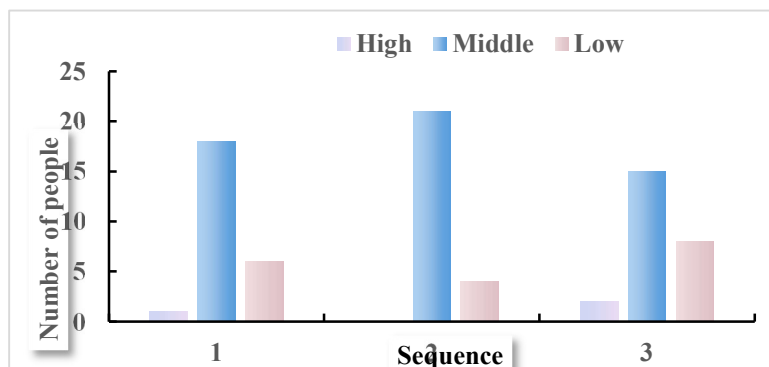

Figure 4: Level of green ecological culture cultivation of enterprises

As shown in Figure 4, on the whole, most employees believed that the enterprise's green ecological culture cultivation level was medium. Analyzing from specific information, in the first interview, only one employee believed that the enterprise's green ecological culture cultivation level was high; 18 employees believed that the enterprise's green ecological culture cultivation level was medium; 6 employees believed that the enterprise's green ecological culture cultivation level was low. In the second interview, no employee thought that the level of green ecological culture cultivation of the enterprise was high; 21 employees thought that the level of green ecological culture cultivation of the enterprise was medium; 4 employees believed that the level of green ecological culture cultivation of the enterprise was low. In the third interview, 2 employees believed that the enterprise's green ecological culture cultivation level was high; 15 employees believed that the enterprise's green ecological culture cultivation level was medium; 8 employees believed that the enterprise's green ecological culture cultivation level was low. It can be seen from the above data that most employees believed that the level of green ecological culture cultivation was still not high enough. Enterprises can use visual design works containing green ecological ideas to improve the level of green ecological culture cultivation.

(2) The public's concept of green and ecological consumption

The public's practice of the concept of green ecological consumption was investigated, as shown in Figure 5 for details.
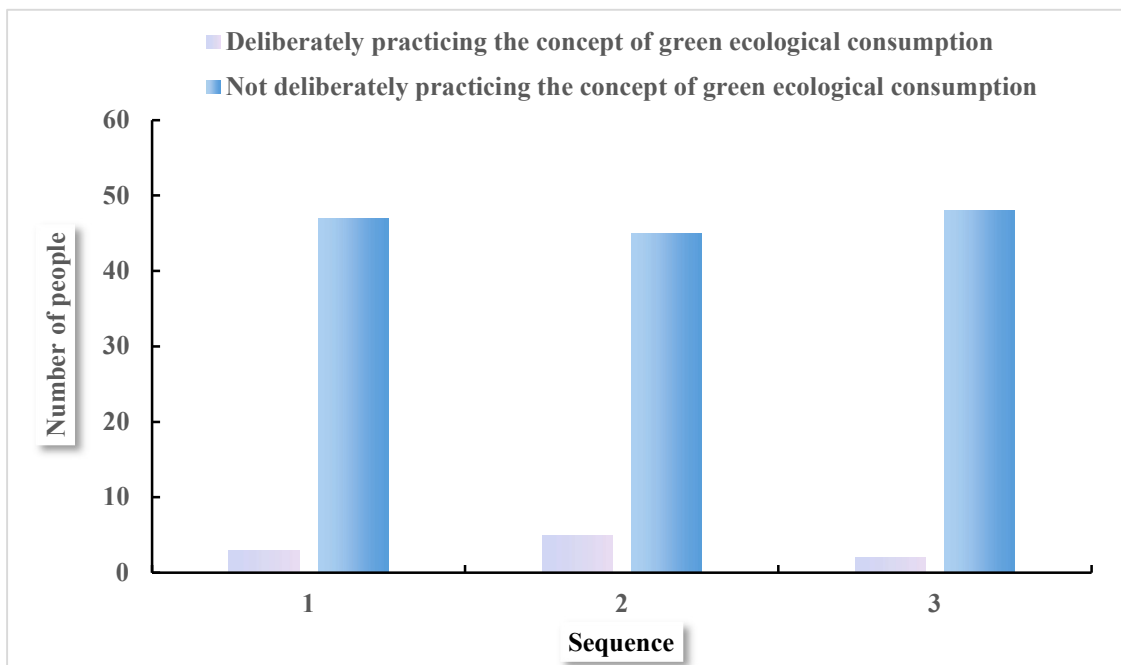

Figure 5: The public's concept of green ecological consumption

As shown in Figure 5, in the first survey, only 3 respondents deliberately practiced the concept of green ecological consumption, while the remaining 47 respondents did not deliberately practice the concept of green ecological consumption in their daily lives. In the second survey, only 5 respondents deliberately practiced the concept of green ecological consumption, while the remaining 45 respondents did not deliberately practice the concept of green ecological consumption in their daily lives. In the third survey, only 2 respondents deliberately practiced the concept of green ecological consumption, while the remaining 48 respondents did not deliberately practice the concept of green ecological consumption in their daily lives. The above data showed that the public's consumption concept needed to be changed. The public's realization of green ecological consumption life was an important link to promote the sustainable development of green ecology. The government can use excellent green ecological public service advertising visual design works to affect the public's consumption concept.

(3) Feedback of the public after watching visual design works

The audience watched the visual design works containing the concept of green ecology, and the significance of realizing green consumption was explained to them. Then their views on practicing the concept of green ecological consumption were asked, as shown in Figure 6 for details.
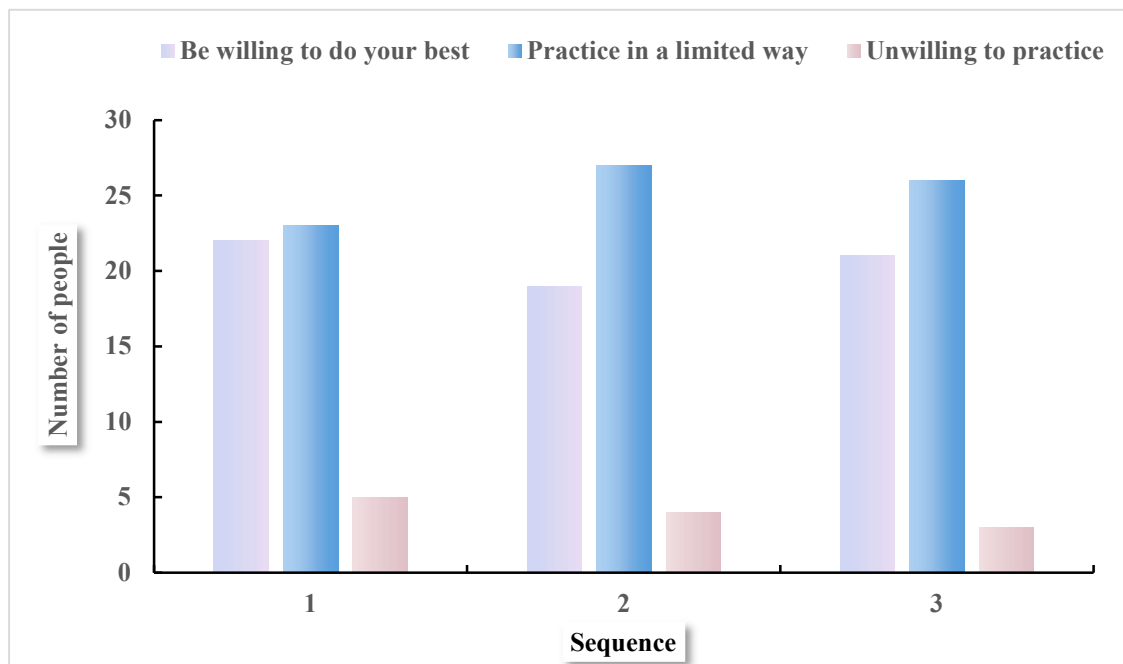
Figure 6: Feedback of the public after watching visual design works

As shown in Figure 6, in the first survey, 22 respondents expressed their willingness to practice the concept of green ecological consumption; 23 respondents said that they could practice the concept of green ecological consumption in a limited way. These 23 respondents believed that they could practice the concept of green ecological consumption in some areas, and they also said that they would not practice the concept of green ecological consumption at all times; 5 respondents expressed their unwillingness to practice the concept of green ecological consumption, and they believed that consumption should follow their own wishes. In the second survey, 19 respondents expressed their willingness to practice the concept of green ecological consumption; 27 respondents said they could practice the concept of green ecological consumption in a limited way; 4 respondents expressed their unwillingness to practice the concept of green ecological consumption. In the third survey, 21 respondents expressed their willingness to practice the concept of green ecological consumption; 26 respondents said they could practice the concept of green ecological consumption in a limited way; 3 respondents expressed their unwillingness to practice the concept of green ecological consumption. According to the results of the three surveys, a total of 62 people were willing to fully practice the concept of green ecological consumption, accounting for 41.33%. From the above data, it can be seen that visual design works containing green ecological concept can have a positive impact on the public's green ecological consumption concept.

VI. Conclusions

This paper summarized the problems existing in visual design, such as the level of theoretical foundation to be improved and the innovation ability of visual design to be enhanced, and put forward the development strategies of visual design, such as strengthening the innovation ability and using technical means to promote the development of visual design. This paper also analyzed the application of clustering algorithm in visual image design, and put forward the implementation strategies of green ecological sustainable development, such as giving play to the guidance and publicity role of the demonstration area, strengthening ecological environment governance and publicity, and described the application of visual design in it. Through demand analysis and effect research, the following conclusions can be drawn: There is still a lot of room for improvement in the level of green ecological culture cultivation of enterprises; the public needs to change into the concept of green ecological consumption; visual design works help to cultivate the public's green ecological consumption concept, thereby promoting the sustainable development of green ecology.

Funding

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