Evaluation of Product Texture Learning Platform Based On Fuzzy Evaluation

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Abstract. In order to better design the product texture learning platform, this paper designs the user experience evaluation scheme and process of the product texture learning platform based on the fuzzy comprehensive evaluation method and user experience measurement. User experience evaluation is divided into three dimensions: performance measurement, visual style measurement and cognitive measurement. Quantitative data of user experience is obtained through task experiment and questionnaire. Based on the fuzzy comprehensive evaluation method, the fuzzy comprehensive evaluation factors are constructed, the evaluation index system of the first and second level indexes is calculated, the interface evaluation value of the product texture learning platform is obtained, and the interface design scheme with the highest evaluation value is selected.

1 Introduction

This paper evaluates the user experience of the product texture learning platform. User experience measurement of low, medium and high complexity interfaces and flat and quasi materialized interfaces, quantitative data are obtained from three dimensions of performance, visual style and cognitive difficulty. Fuzzy comprehensive evaluation method is used to evaluate the combination of visual style and interface complexity and screen out the evaluation the highest value interface solves the evaluation problem of computer learning platform, and provides reference for the design of product texture learning platform.

2 Acquisition of user experience measurement data

The user experience measurement of product texture learning platform is carried out from three dimensions of performance measurement, cognitive difficulty and visual style. The performance dimension obtains the quantitative data of user's completion time and learning efficiency through task experiment; the cognitive difficulty dimension obtains the first click time when the subject finds the designated position on the page through the software that can record the mouse click, and obtains the quantitative data of user's subjective feelings through the NASA-TLX system questionnaire; the user's pseudo materialization and learning efficiency in the visual style dimension Two kinds of flat visual style interface are used for visual texture evaluation and user experience evaluation.
2.1 Performance measurement

Performance measurement used in usability evaluation refers to the completion of tasks when users operate a product or browse a web page. Performance measurement depends on the setting of tasks. The whole measurement is based on the designed tasks and has clear instructions for task completion. Performance measurement mainly tests users' task time and learning efficiency.

In the performance measurement experiment, 24 subjects were recruited. 24 subjects were divided into three groups, 8 in each group, and completed test 1, test 2 and test 3 respectively. In order to avoid the influence of learning effect on the test, the subjects will complete the test questions corresponding to the product texture after each learning, and obtain the learning effect data through the scores of the completed test questions as follows.

| Interface | Test 1 Efficiency | Test 2 Efficiency | Test 3 Efficiency | Average Efficiency |
|-----------|------------------|------------------|------------------|-------------------|
| Low       | 57.02s           | 53.63s           | 53.13s           | 54.59s            |
| Medium    | 75.06s           | 76.92s           | 97.52s           | 83.17s            |
| High      | 90.99s           | 88.05s           | 100.19s          | 93.78s            |

Through the task experiment, 14 task time data, 3 learning achievement data of 24 subjects were obtained, and the ratio of learning achievement to corresponding learning task time was taken as the efficiency data. The learning time and efficiency of three groups of users in three interface complexity interfaces are shown in Table 2.

2.2 Visual style measurement

This part is to obtain the quantitative data of the impact of visual style on user experience. The research uses the 7-level Likert scale to obtain the data. Visual style is an important part of the current interface design.

| Materialization | Visual texture | User experience | Delayering | Visual texture | User experience |
|-----------------|----------------|-----------------|------------|----------------|-----------------|
| Average         | 3.76           | 3.79            | 4.71       | 4.74           |

In the visual measurement experiment, the texture interface of quasi materialized visual style products and the texture interface of plane visual style products are used as the experimental materials. In order to eliminate the interaction between two visual style interfaces, play the next one every 30 seconds, and fill in the questionnaire according to the same process. In this experiment, 34 questionnaires were collected to measure the visual texture and user experience of the interface from the visual style dimension. The results are shown in the table above.

2.3 Measurement of cognitive difficulty

Cognitive difficulty measurement is a quantitative measurement of the user's cognitive difficulty of the interface. The measurement data is the time data and subjective feeling score of the first time to recognize the target point, and the quantitative data of the user's cognitive difficulty of the interface with different complexity is obtained.
Table 3. Data of subjective feeling questionnaire and first cognition time.

| Number | 1    | 2    | 3    | 4    | 5    | 6    | Cognition |
|--------|------|------|------|------|------|------|-----------|
| Low    | 4.000| 3.714| 3.786| 4.214| 3.786| 4.714| 2.12      |
| Medium | 3.857| 3.929| 3.857| 4.571| 3.500| 4.714| 2.89      |
| High   | 3.786| 3.643| 4.071| 3.857| 3.857| 4.429| 3.49      |

Subjective perception was measured by NASA-TLX questionnaire, which was used to measure the cognitive load of subjects in cognitive experiments. The time data of recognizing the target point for the first time comes from the time between the user's appearance of the interface and clicking the specified target point as the data. The results are shown in the table above.

3 Fuzzy comprehensive evaluation analysis

3.1 Fuzzy comprehensive evaluation factors

3.1.1 Construction of evaluation index system

According to the data obtained from user experience measurement, the first level indicators of fuzzy comprehensive evaluation index are divided into performance measurement, visual measurement and cognition measurement. The second level indicators are analysed according to the main factors of the first level indicators, and expressed as follows by mathematical set.

\[ U = \{ C_1, C_2, \ldots, C_n \} \quad (1) \]

Table 4. Main indicators of user experience evaluation.

| One-level indicators | Two-level indicators                      |
|----------------------|-------------------------------------------|
| Performance measurement U_1 | Task time C_1, Learning efficiency C_2 |
| Visual style measurement U_2 | Visual texture score C_3, User experience score C_4 |
| Measurement of cognitive difficulty U_3 | Cognitive time C_5, Subjective perception score C_6 |

3.1.2 Determine comment set

According to the construction of the above evaluation index system, taking performance measurement as an example, the second level indicators are task time and learning efficiency. Considering that task time contains 14 tasks, the set of performance measurement and corresponding comment set be expressed as follows. The evaluation set of other indicators also refers to this evaluation set.

\[ V = \{ v_1, v_2, v_3, v_4, v_5 \} \quad (2) \]

3.1.3 Membership function

For the same fuzzy concept, it can be expressed by different membership functions. Because the selected membership functions are different, an element in the domain has different membership degrees for different membership functions. Based on the characteristics of the index data in this paper, triangle function is selected as the membership function from the commonly used membership functions.
3.1.4 One-factor fuzzy evaluation matrix

Each evaluation factor is evaluated independently to determine the membership function of the evaluated object relative to the evaluation set \( V \), and the membership degree is calculated as the evaluation value \( r \). If that the evaluation is based on the \( i \)th specific factor in the \( U \)th layer of the factor set, and the membership degree value of the evaluation for the \( j \)th element in the evaluation set \( V \) is \( r \), then the evaluation result of this element can be expressed in the way of fuzzy set. After each factor is evaluated, the following matrix can be obtained.

\[
R = \begin{bmatrix}
    r_{11} & \cdots & r_{1m} \\
    \vdots & \ddots & \vdots \\
    r_{m1} & \cdots & r_{km}
\end{bmatrix}
\]  

(3)

3.2 Index weight calculation

First, determine the weight of index factors, divide the user experience evaluation factors into different levels, and then build a judgment matrix for the evaluation indexes. Saaty scale method is used to determine the impact value. The final influence value is calculated by using the trust coefficient. According to the scale and the corresponding importance level, the judgment matrix is constructed by comparing the elements in the evaluation factor set.

The greater the consistency ratio calculated, the worse the consistency of the judgment matrix \( [2] \). Otherwise, the better the consistency is. When it is equal to or equal to, it means that the judgment matrix is completely consistent. When CR is less than 0.1, it can be considered that the consistency of the judgment matrix is good and the test can pass.

According to the results of experts' discussion on the weights of primary and secondary indicators, the specific weights of primary and secondary indicators are obtained, as shown in the table below \( [3] \). By calculating the relative weight value and weight eigenvector of the first level index, the actual weights of the three first level indexes are obtained. Then, according to the actual weight value, the consistency test index \( CR = 0 \) of the first level index discrimination matrix can pass the test.

| Measurement         | Performance | Visual style | Cognitive difficulty | Weight |
|---------------------|-------------|--------------|----------------------|--------|
| Performance         | 1           | 2/3          | 2                    | 0.333  |
| Visual style        | 3/2         | 1            | 3                    | 0.5    |
| Cognitive difficulty| 1/2         | 1/3          | 1                    | 0.167  |

The calculation of the second level index weight is similar to that of the first level index weight. The consistency test ratio of the judgment matrix of the secondary indicators of the performance dimension is 0.0016. The index weights are 0.043, 0.043, 0.079, 0.113, 0.043,
0.043, 0.079, 0.113, 0.043, 0.079, 0.113, 0.043, 0.079, 0.079. The consistency test ratio of visual style measurement secondary index is 0, and the actual weight is 0.333 and 0.667. The consistency test ratio of the second level indicators of cognitive difficulty measurement is 0.0033, and the actual weight is 0.250, 0.250, 0.125, 0.079, 0.079, 0.092, 0.125. The second level indicators can pass the consistency test.

3.3 Calculation of fuzzy comprehensive evaluation value

On the basis of the single factor fuzzy evaluation matrix obtained in the previous paper, the single-layer comprehensive evaluation matrix is obtained as follows, and then combined with the membership function, the final evaluation results can be obtained.

\[ B=W \ast R=(w_1, w_2, ..., w_n) \ast R \]  \hspace{1cm} (4)

Table 6. Comprehensive evaluation vector and score.

| Interface type          | V1  | V2  | V3  | V4  | V5  | Score  |
|-------------------------|-----|-----|-----|-----|-----|--------|
| Low materialization     | 0.281 | 0.296 | 0.222 | 0.153 | 0.048 | 0.7218 |
| Low delayering          | 0.277 | 0.333 | 0.175 | 0.139 | 0.076 | 0.7192 |
| Medium materialization  | 0.221 | 0.261 | 0.275 | 0.171 | 0.072 | 0.6776 |
| Medium delayering       | 0.216 | 0.298 | 0.229 | 0.157 | 0.100 | 0.6746 |
| High materialization    | 0.199 | 0.245 | 0.279 | 0.197 | 0.080 | 0.6572 |
| High delayering         | 0.194 | 0.282 | 0.232 | 0.183 | 0.109 | 0.6538 |

According to the formula, the evaluation vector of the secondary index is calculated. Combined with the actual weight of the first level index, the evaluation vector of the interface with low interface complexity and visual style is obtained. Substitute the evaluation vector into the evaluation set to get the score value of each interface, as shown in the table above. The final comprehensive score of low information complexity and pseudo materialized style interface score of 0.7218, which is higher than the other interfaces, low information complexity and pseudo materialized style should be used for design.

4 Summary and prospect

This paper obtains data through user experience measurement, uses fuzzy comprehensive evaluation method to process the data and calculate the evaluation value of different interfaces, and selects the interface design scheme and visual style for the design of product texture learning platform. It provides ideas and references for the user experience evaluation of computer learning platform.

References

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