

Measuring Aesthetics of Mandarin Learning Web Pages: Are Users' Perceptions Congruent with the Measured Values of Aesthetics-Measurement Application (AMA)?

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Abstract — Aesthetics of web pages refers to how attractive a web page is in which it catches the attention of the user to read through the information. Visual appearance is important in getting attentions of the users. It was found that there is a positive correlation between the aesthetic aspects and the perceived usability of Virtual Learning Environments (VLE) interfaces [6]. It was also found that those screens which were perceived as aesthetically pleasing were having a better usability [7]. It is thus suggested that the more aesthetic a web page is, the more useful the web page can be. Therefore, the measurement of aesthetics can be viewed as an important task that should not be disregarded. For this research, the positions of objects, images element and texts element are defined as objects in a multi screen interface and are measured. Mandarin learning web pages used in this research comprised of main pages, learning pages and exercise pages, on the first author's E-portfolio web site. The web pages were manipulated according to the desired aesthetic values. The six aesthetics related elements used are balance, equilibrium, symmetry, sequence, rhythm, as well as order and complexity. On top of it, questionnaires were distributed to the users to gather information on the students' perceptions on the aesthetic aspects. Respondents for this study were students taking Mandarin course level I at UiTM Terengganu. It was found that the users' perceptions were congruent with the aesthetics values measured by using our self-developed Aesthetics-Measurement Application (AMA). Hence, our AMA perhaps can be introduced as an effortless tool for web page aesthetics measurement.

INTRODUCTION

Aesthetics of web pages refers to how attractive a web page is in which it catches the attention of the user to read through the information. Visual appearance is important in getting attentions of the users to browse through the entire web pages. It was found that those screens, which were perceived as aesthetically pleasing, were having a better usability [7]. In addition, aesthetic measuring methods of web page interface are important as this may help in gaining students' attention and in erecting their interest in using the interface. However, aesthetics of the web page interfaces can be very subjective. Different people might have different views and opinions. Therefore, it is normally very difficult to judge whether an interface is exquisite or not. Consequently, the major concern of this research is to provide an objective tool for unbiased aesthetics measurement whereby the users' perceptions are supposed to be congruent with the aesthetic values of the Aesthetics-Measurement Application (AMA) used. This is to ease the measurement of aesthetics of Mandarin learning web pages particularly and web pages of any languages generally in the future.

In order to achieve the above-mentioned purpose, Mandarin learning web pages used for this research comprise of main pages, learning pages and exercise pages that were manipulated according to the desired aesthetic values. The six aesthetics related elements used are balance, equilibrium, symmetry, sequence, rhythm, as well as order and complexity. With this intention, the study was held to gather students' views on the aesthetic aspects. It was found that the users' perceptions were congruent with the aesthetics values gathered by using our self-developed Aesthetics-Measurement Application (AMA). Hence, our AMA perhaps can be introduced as an effortless tool for web page aesthetics measurement.

LITERATURE REVIEW

Efforts have been carried out for aesthetics measurements. Approaches and ways of measuring aesthetics were conducted.

The calculations and technique of aesthetics measurement for web page interface were derived from the past research. An essential research that focused on measuring aesthetic value for graphic screens had been done [2]. These researchers have discovered fourteen aesthetic measurements elements, which were balance, equilibrium, symmetry, sequence, cohesion, unity, proportion, simplicity, density, regularity, economy, homogeneity, rhythm, as well as order and complexity.

Researches have been conducted on the relevance of aesthetics to interface designs [2] [5] [9]. Prior studies done on the aesthetic aspects of interfaces focused prematurely on visual design elements as the objects and the effects on the usability [3]. Additionally, symmetry was found as the most fundamental principle in interface design and it would affect the layout, as a consequence feeling of a design as a symmetrical page might give a feeling of permanence and stability but asymmetrical balance might impel interest and should not be neglected [1].

It as also found that there was a positive correlation between the aesthetic aspects and perceived usability of Virtual Learning Environments (VLE) interfaces [6]. It was also found that those screens, which were perceived as aesthetically pleasing, were having a better usability [7].

In addition, good aesthetic layouts definitely affect a student's motivation to learn [8], as related to ARCS model [4]. The ARCS model refers to Attention, Relevance, Confidence, and Satisfaction. It was also found that aesthetically pleasing layouts of web page motivate students in Mandarin learning [5].

This research further validates these findings. This is to broaden the significance for aesthetics measurements that is vastly related to language learning specifically and learning on the whole.

APPROACH AND METHODOLOGY

This research was carried out in two major parts. The first part concentrated on GUI aesthetics measurement by using our self-developed Aesthetics-Measurement Application (AMA). The second part was to collect users' perceptions of the aesthetic aspects on web page Interfaces created and measured in the previous part.

Part A: Self-developed Aesthetics-Measurement Application (AMA)

A self-developed aesthetic measurement application was developed by using Matlab software based on six elements derived from the model of Ngo, Teo, and Byrne (2002) [2]. These six elements were balance, equilibrium, symmetry, sequence, rhythm, as well as order and complexity. Table 1 showed the explanations of terms used and the formulae used for aesthetics measurements.

TABLE 1
AESTHETIC MEASURES

| | |
|---|---|
| <p>1. Balance</p> $Balance = 1 - \frac{ BalanceVer + BalanceHor }{2} \in [0,1]$ | <p>2. Equilibrium</p> $Equilibrium m = 1 - \frac{ Equilibrium m_x + Equilibrium m_y }{2} \in [0,1]$ |
| Balance in screen design was achieved by providing an equal weight of screen elements, left and right, top, and bottom. | Equilibrium on a screen was accomplished through centering the layout itself. |
| <p>3. Symmetry</p> $Symmetry = 1 - \frac{ SymmetryVer + SymmetryHor + SymmetryRad }{3}$ | <p>4. Sequence</p> $Sequence = 1 - \frac{\sum_{j=UL,UR,LL,LR} q_j - v_j }{8} \in [0,1]$ |
| Symmetry was axial duplication where a unit on one side of the centerline was exactly replicated on the other side. There were three types of symmetry, which were vertical symmetry, horizontal symmetry, and radial symmetry. | Sequence in design referred to the arrangement of objects in a layout in a way that facilitated the movement of the eye through the information displayed. |
| <p>5. Rhythm</p> $Rhythm = 1 - \frac{ Rhythm_x + Rhythm_y + Rhythm_{Area} }{3} \in [0,1]$ | <p>6. Order and Complexity</p> $Order - Complexity = \frac{\sum_i^5 M_i}{5} \in [0,1]$ |
| Rhythm was accomplished through variation of arrangement, dimension, number, and form of the elements. The extent to which rhythm was introduced into a group of elements depends on the complexity. | The measure of order was written as the sum of the above measures for a layout. The opposite pole on the continuum was complexity. The scale created might also be considered as a scale of complexity, with extreme complexity at one end and minimal complexity (order) at the other. |

Figure 2 to 4 showed the twelve Mandarin learning web pages with its web page interfaces and object models respectively. These web pages were developed and designed according to the required aesthetic values. They were altogether four main pages, four learning pages and four exercise pages. They were arranged into four categories, which were labeled as Main Page 1, Main Page 2, Main Page 3, and Main Page 4, Learning Page 1, Learning Page 2, and subsequently.

The object models of the Mandarin learning web page interfaces were manipulated through image processing by using Photoshop program. These object models were used as modeling of the web page interfaces and showed the objects on each of the Mandarin learning web page interface clearly.

TABLE 2
MAIN PAGE OF MANDARIN LEARNING WEB PAGE INTERFACES AND ITS OBJECT MODELS


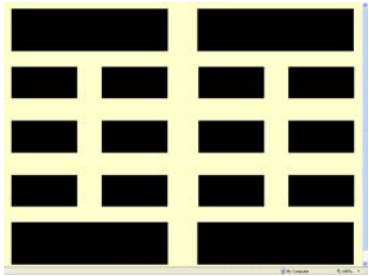

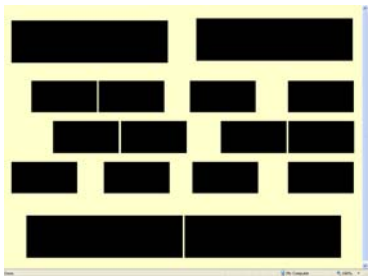

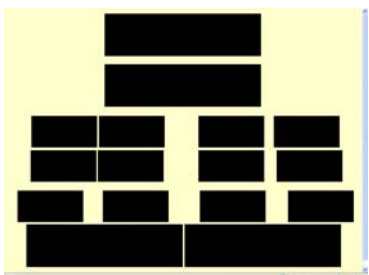

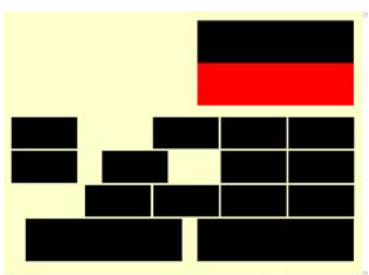
| | Mandarin Learning Web page Interface | Object Model of Interface |
|-------------|---|--|
| Main Page 1 |  |  |
| Main Page 2 |  |  |
| Main Page 3 |  |  |
| Main Page 4 |  |  |

TABLE 3
 LEARNING PAGE OF MANDARIN LEARNING WEB PAGE INTERFACES AND ITS OBJECT MODELS





















| | Mandarin Learning Web page Interface | Object Model of Interface |
|-----------------|---|--|
| Learning Page 1 |  |  |
| Learning Page 2 |  |  |
| Learning Page 3 |  |  |
| Learning Page 4 |  |  |

TABLE 4
EXERCISE PAGE OF MANDARIN LEARNING WEB PAGE INTERFACES AND ITS OBJECT MODELS

| | Mandarin Learning Web page Interface | Object Model of Interface |
|-----------------|--------------------------------------|---------------------------|
| Exercise Page 1 | | |
| Exercise Page 2 | | |
| Exercise Page 3 | | |
| Exercise Page 4 | | |

Table 5 showed the results of aesthetic values of twelve web pages used in our research. These values were between 0 and 1, where 0 referred to the worst and 1 referred to the best. In addition, the values of five elements involved in the aesthetics measurement were also included. They were Balance, Equilibrium, Symmetry, Sequence, and Rhythm.

TABLE 5
RESULTS OF AESTHETIC VALUES (AVS) OF MANDARIN LEARNING WEB PAGES BY USING AMA

| Group | Main Page | Learning Page | Exercise Page |
|---------------------|---|---|---|
| Main Page (Group 1) |  <p>Balance 0.9445 Equilibrium 0.9991 Symmetry 0.9013 Sequence 1.0000 Rhythm 0.9085 Aesthetic value (av) 0.9507</p> |  <p>Balance 0.6558 Equilibrium 0.9954 Symmetry 0.6062 Sequence 0.7500 Rhythm 0.6663 Aesthetic value (av) 0.7347</p> |  <p>Balance 0.8054 Equilibrium 0.9965 Symmetry 0.4402 Sequence 0.7500 Rhythm 0.5592 Aesthetic value (av) 0.7103</p> |
| Main Page (Group 2) |  <p>Balance 0.9369 Equilibrium 0.9990 Symmetry 0.8234 Sequence 1.0000 Rhythm 0.8700 Aesthetic value (av) 0.9259</p> |  <p>Balance 0.5784 Equilibrium 0.9945 Symmetry 0.4161 Sequence 0.7500 Rhythm 0.4917 Aesthetic value (av) 0.6461</p> |  <p>Balance 0.6911 Equilibrium 0.9932 Symmetry 0.3796 Sequence 0.7500 Rhythm 0.4331 Aesthetic value (av) 0.6494</p> |
| Main Page (Group 3) |  <p>Balance 0.7656 Equilibrium 0.9960 Symmetry 0.4958 Sequence 0.6250 Rhythm 0.5324 Aesthetic value (av) 0.6830</p> |  <p>Balance 0.5309 Equilibrium 0.9935 Symmetry 0.4555 Sequence 0.5000 Rhythm 0.4870 Aesthetic value (av) 0.5934</p> |  <p>Balance 0.5944 Equilibrium 0.9913 Symmetry 0.4515 Sequence 0.5000 Rhythm 0.3459 Aesthetic value (av) 0.5766</p> |
| Main Page (Group 4) |  <p>Balance 0.5674 Equilibrium 0.9918 Symmetry 0.2689 Sequence 0.3750 Rhythm 0.2258 Aesthetic value (av) 0.4858</p> |  <p>Balance 0.5411 Equilibrium 0.9934 Symmetry 0.3399 Sequence 0.3750 Rhythm 0.3511 Aesthetic value (av) 0.5201</p> |  <p>Balance 0.3296 Equilibrium 0.9859 Symmetry 0.3421 Sequence 0.5000 Rhythm 0.3134 Aesthetic value (av) 0.4942</p> |

Part 2: Users' Perceptions of the Aesthetic Aspects of Web Page Interfaces

In order to gather users' perceptions, Mandarin learning web pages above, and self-developed questionnaires were used. In this research, non-random sampling method was used to gather the information needed.

60 students from two classes who were taking Mandarin level I course (BMD 401) at University of Technology MARA Terengganu were involved. One class was from Faculty of Accountancy and another was from Faculty of Business Management and Faculty of Office Management. Table 6 showed the respondents' background.

TABLE 6
RESPONDENTS' BACKGROUND

| Program | Gender | | Total |
|---|----------|-----------|-----------|
| | Male | Female | |
| Bachelor in Accountancy | 0 | 19 | 19 |
| Bachelor in Office Management & Technology | 5 | 30 | 35 |
| Bachelor in Business Management (Marketing) | 2 | 4 | 6 |
| Total | 7 | 53 | 60 |

The web pages were showed to the students by using projector in the form of Power point slides. Each slide showed a web page interface, started by Main page 1 followed by Main page 2, Main page 3, and Main page 4, then followed by Learning pages and Exercise pages subsequently. Each interface was showed in 30 seconds. The students were asked to judge the aesthetic aspects of the pages shown by using Likert scale from 1-5 where 1 means the worst and 5 means the best. The students were asked to rate 8 items per page.

FINDINGS AND DISCUSSIONS

Table 7 to 9 showed the results of four Main pages, four Learning Pages and four Exercise pages according to the students' perceptions. From the results, the mean of the web pages from the category 1 was the highest, followed by category 2, category 3, and category 4.

TABLE 7
MEAN OF FOUR MAIN PAGES

| CATEGORY | N | Min | Max | Mean |
|-------------------|----|------|------|--------|
| Main Page 1 | 60 | 1.00 | 5.00 | 4.1729 |
| Main Page 2 | 60 | 1.00 | 5.00 | 3.2104 |
| Main Page 3 | 60 | 1.00 | 4.88 | 3.1313 |
| Main Page 4 | 60 | 1.00 | 4.75 | 2.5792 |
| ValidN (listwise) | 60 | | | |

TABLE 8
MEAN OF FOUR LEARNING PAGES

| CATEGORY | N | Min | Max | Mean |
|--------------------|----|------|------|--------|
| Learning Page 1 | 60 | 1.13 | 5.00 | 4.2813 |
| Learning Page 2 | 60 | 1.00 | 5.00 | 3.9167 |
| Learning Page 3 | 60 | 1.00 | 4.75 | 2.8812 |
| Learning Page 4 | 60 | 1.00 | 4.88 | 2.4542 |
| Valid N (listwise) | 60 | | | |

TABLE 9
MEAN OF FOUR EXERCISE PAGES

| CATEGORY | N | Min | Max | Mean |
|--------------------|----|------|------|--------|
| Exercise Page 1 | 60 | 1.00 | 5.00 | 4.2792 |
| Exercise Page 2 | 60 | 2.00 | 5.00 | 3.9354 |
| Exercise Page 3 | 60 | 1.00 | 4.88 | 2.9417 |
| Exercise Page 4 | 60 | 1.00 | 4.63 | 2.3958 |
| Valid N (listwise) | 60 | | | |

Table 10 showed the comparisons between the ranking of results using Aesthetics-Measurement Application (AMA) and students' perceptions. The results of the application showed that web pages of category 1 were the most aesthetic, and followed by category 2, category 3, and the category 4.

The ranking were the same for both application and users' perception. The ranking of category 1 stayed at the first position for main pages, learning pages as well as exercise pages. This was followed by category 2, category 3, and category 4.

As the result, it was quite convincing to claim that users' perceptions were congruent with the aesthetics values measured using our Aesthetics-Measurement Application (AMA).

However, it was noted that, values calculated for Main page 2 and 3 using our Application were quite a big different ($0.9259 - 0.683 = 0.2429$), while values calculated for Main page 2 and 3 from users' perception were not so much different ($(3.2104 - 3.1313)/5 = 0.0158$). It might be due to the shortcomings in the designs of Main page 2 and 3.

In relating to the discussions above, Table 11 showed the result of ANOVA test (F-Test) used. With F value = 6.907, significant value = .000 (smaller than 0.05), it was significant. Therefore, the differences in the views of the students on the aesthetics of web pages were significant. The students did have positive views for the web pages in Category 1 and the worst view of the web pages in Category 4.

TABLE 11
ANOVA TEST (F-TEST) FOR COMPARING MEANS AMONG THE USERS' PERCEPTIONS

| | df | Mean ² | F | Sig. |
|----------------|------------|-------------------|--------|-------------|
| Between Groups | 3 | 36.144 | 59.967 | .000 |
| Within Groups | 236 | .603 | | |
| Total | 239 | | | |

TABLE 10
COMPARISON BETWEEN RANKING OF THE RESULTS OF APPLICATION & QUESTIONNAIRE

| CATEGORY | Application (ranking) | | | Questionnaire (ranking) | | |
|----------|-----------------------|------------|------------|-------------------------|------------|------------|
| | Web page | | | Web page | | |
| | Main | Learning | Exercise | Main | Learning | Exercise |
| 1 | 0.9507 (1) | 0.7347 (1) | 0.7103 (1) | 4.1729 (1) | 4.2813 (1) | 4.2792 (1) |
| 2 | 0.9259 (2) | 0.6461 (2) | 0.6494 (2) | 3.2187 (2) | 3.9167 (2) | 3.9354 (2) |
| 3 | 0.6830 (3) | 0.5934 (3) | 0.5766 (3) | 3.1313 (3) | 2.8812 (3) | 2.9417 (3) |
| 4 | 0.4858 (4) | 0.5201 (4) | 0.4942 (4) | 2.5792 (4) | 2.4542 (4) | 2.3958 (4) |

IMPLICATIONS, SUGGESTIONS AND CONCLUSION

The findings showed a positive result, as a whole of our claims that is the aesthetics values measured using our application were congruent with the students' views. The ranking for all categories from the students' perceptions were alike as the measurements using our Aesthetics-Measurement Application (AMA). Thus, the calculations and technique of aesthetics measurement for web page interface in this research can be used. Hence, our AMA perhaps can be introduced as an effortless tool for web page aesthetics measurement.

However, it was noted that, the difference of values calculated for Main page 2 and 3 using our Application was higher than the difference of values of the students. It might be due to the shortcomings in the designs of these two Main pages, namely main page 2 and 3 in which the two pages could be not so distinctly different in terms of their aesthetic disparity. It might be also due to the difference in the ways the values were collected. One was using formulae to get aesthetic values while the other using means of the perceptions from questionnaires. The discrepancies might be caused. Another issue could also be the issue of subjectivity. It might be that most of the students agreed that the Main page 3 was also as visually appealing as Main page 2 although the aesthetic values of these two interfaces were clearly differentiated using our application. It might also imply that aesthetics might be measured in a way that is more deliberate compared to human judgment.

Taking as a whole, our Aesthetics-Measurement Application (AMA) can still be considered as a viable tool in evaluating the aesthetics of an interface. What can be improved is that, there were only six aesthetic elements used to develop this application. Thus, more aesthetics measurers should be entailed in developing a more powerful web page interface aesthetics-measuring tool.

Furthermore, measuring aesthetic of interface can also include shapes of objects, colors of objects, texts, frames, and background of screen. This research can also be extended to the measuring of aesthetics of multi windows, multi document, and multi pane interfaces.

In conclusion, measurement of aesthetics can be viewed as an important task that should not be disregarded. This is because aesthetics of interface

would influence usability, acceptability, learnability, comprehensibility, and productivity. It is thus suggested that the more aesthetic a web page is, the more useful the web page can be. In advocating the contentions of these researchers that the more aesthetic the web pages, the more it could motivate students to learn Mandarin particularly and for learning in general [5].

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