Jurnal Elektro
p-ISSN: 1979-9780
e-ISSN: 2746-4288

Jurnal Elektro Vol.15 No.2 Oktober 2022
journal homepage: https://ejournal.atmajaya.ac.id/index.php/JTE

A Preliminary Survey of Color Discrimination Among Indonesia Female Subjects Using *Farnsworth-Munsell Hue Color Test*

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Article Info

Article history:

Received
10-12-2023

Accepted
17-12-2023

Keywords:
Color discrimination, FM Hue Color Test, Indonesia females

Abstract

This study aimed to conduct a preliminary survey of the color discrimination test among Indonesian samples. The study involved 26 participants of university students and office workers. To test the ability of color discrimination, the Farnsworth-Munsell (FM) 100 Hue Color Vision Test was used. Farnsworth-Munsell test scoring software was also used to obtain the total score of each participant. Using the FM 100-hue test, the participants were classified into superior, average and low color discrimination ability. The results showed that that 19.2% female participants were classified as superior for color discrimination ability. Majority of participants were classified as average. Meanwhile for low classification, only 3.9% were classified as low color discrimination ability. Currently, many companies and industries have great need for workers with good characterized and accurate color vision. However, the study of color discrimination is still limited and unknown in Indonesia. Through this study, hopefully attention for a broader study with a larger scale could be obtained.

Info Artikel

Histori Artikel:

Diterima:
10-12-2023

Disetujui:
17-12-2023

Kata Kunci:
Diskriminasi warna, FM Hue Color Test, Perempuan Indonesia

Abstrak

Penelitian ini bertujuan untuk melakukan survei awal tes diskriminasi warna di antara sampel Indonesia. Penelitian melibatkan 26 peserta yang terdiri dari mahasiswa universitas dan pekerja kantor. Untuk menguji kemampuan diskriminasi warna, digunakan Tes Penglihatan Warna Farnsworth-Munsell (FM) 100 Hue. Perangkat lunak penilaian tes Farnsworth-Munsell juga digunakan untuk mendapatkan skor total setiap peserta. Dengan menggunakan tes FM 100-hue, peserta diklasifikasikan menjadi kemampuan diskriminasi warna yang superior, rata-rata, dan rendah. Hasil menunjukkan bahwa 19,2% peserta perempuan diklasifikasikan sebagai kemampuan diskriminasi warna yang superior. Sebagian besar peserta diklasifikasikan sebagai rata-rata. Sementara itu, untuk klasifikasi rendah, hanya 3,9% yang diklasifikasikan sebagai kemampuan diskriminasi warna rendah. Saat ini, banyak perusahaan dan industri membutuhkan pekerja dengan kemampuan penglihatan warna yang baik dan akurat. Namun, studi tentang diskriminasi warna masih terbatas dan belum diketahui di Indonesia. Melalui penelitian ini, diharapkan perhatian untuk studi lebih luas dengan skala yang lebih besar bisa diperoleh.

1. INTRODUCTION

Color vision testing forms an essential part of physical requirements for certain occupations and eye-care professionals are often required to administer various tests for its evaluation [1]. There are several types of color vision tests which can be used such as Ishihara test for color blindness, Cambridge color test, Anomaloscope-color blind test and Farnsworth-Munsell 100 Hue Color Vision Test. Many different color blindness tests are all based on the retinal modelling of the color stimulus [2]. The FM 100-hue test is a psycho-technical arrangement test first devised by Farnsworth in 1943 to test hue discrimination among subjects with normal trichromatic vision as well as defective color vision and to evaluate specific decrements in R-G and B-Y axes.

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The FM 100-hue test is one of color test to measure color discrimination, the ability to discriminate between various shades of a given color [3]. This test could classify persons with normal color vision into three classes, superior, average and low color discrimination. In industry, this test is used to test employees in color control laboratories involved in the manufacture of paints and dyes, textiles and photographic materials since these occupations require accurate color discrimination.

In Indonesia, color blindness tests using Ishihara have been widely carried out. However, the published study of the FM 100-hue to measure color discrimination is still limited. Hence, this study aims to conduct a survey of color discrimination among students. Through this study, hopefully a broader study with a larger scale can be carried out in the future.

2. METHODOLOGY

This study involved 26 female participants. Their occupations are university students and office workers. They resided in Greater Jakarta, Indonesia. Farnsworth-Munsell 100 Hue Color Vision Test was used in this study. The instrument contains four trays, each containing 21 distinct variations (Figure 1). The rows include orange/magenta hues, yellow/green hues, blue/purple hues and purple/magenta hues. To obtain the total score of each participant, Farnsworth-Munsell test scoring software was used. The software was installed into computer. Using this software, the total error score (TES) for each participant could be calculated and then being used to classify for low, average or superior at discriminating color.

Figure 1. Farnsworth-Munsell hue colort test used in this study

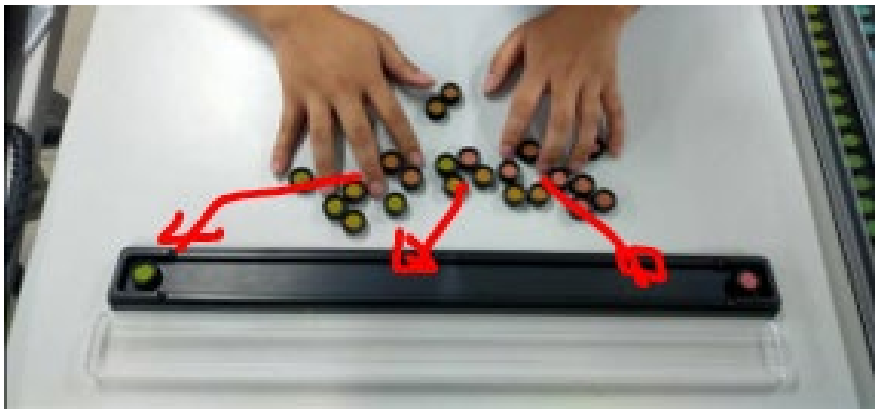

Figure 2. A test for the first by participants

Before testing, the participant's personal data was recorded including name, age and daily computer/gadget usage. Prior to testing using Farnsworth-Munsell hue colort test, the participant was

informed about the objective of study and the procedure for Farnsworth-Munsell hue colort test. The instrument contains four distinct trays of similar color hues. Each row contains 21 variations of each hue. In the beginning of the test, the first tray was selected and the round pins, called *color hue caps* were put in random outside the tray (See Figure 2). The participants were tasked to place the color hue caps in a specific order of hue. Similarly, the same task was performed by participants for the second, third and fourth trays. Subsequently, the results were ready to be analyzed by using Farnsworth-Munsell test scoring software (see illustration in Figure 3).

Once a participant finished to place all 4 tasks, the next step is the scoring. For each tray, two pilot colors are fixed at the two end of the box. Considering that the participant was asked to order the cap in the series of color which gradually changing from the first, the second to the end, the scoring was based on the placement or misplacement of color caps in the series. The scoring is done by by flipping the color cabs so that each sequence number is visible (see Figure 4). Subsequently, the sequence numbers were analyzed by using Farnsworth-Munsell test scoring software.

Figure 3.The sequence number in the back side of the cab

3. RESULTS AND DISCUSSION

The results of the FM 100-hue test classified female subjects into superior, average and low color discrimination ability (presented in Table 1). The results of color discrimination test showed that 19.2% female participants were classified as superior for color discrimination ability. Majority of participants were classified as average. Meanwhile for low classification, only 3.9% were classified as low color discrimination ability (see Table 1).

Table 1. The results of the FM 100-Hue test

No.	Classification	Test score range	Percentage (%)
1	Superior	0-16	19.2
2	Average	17-100	76.9
3	Low	>100	3.9

Regarding Table 1 and using Farnsworth-Munsell test scoring software, the results for each participant was depicted by a polar graph as in Figure 5. Figure 5 depicts an example polar graph of *Superior classification* for female participant. Meanwhile, Figure 5 depicts an example polar graph of *low classification*. Studying Figure 4, the polar graph almost forms a perfect circle with a small hump in the range of 52-55. It means that the color swapped for number 53 and 54. Studying Figure 5 and Figure 6, we can observe that the shape of the polar graph between the superior class and the low class is very different. The graph has many humps from different sides at different heights. The higher the hump, the more it indicates a lack of ability to diffrentiate the color of that type. Furthermore, the more humps indicate the more color groups that the subject cannot distinguish.

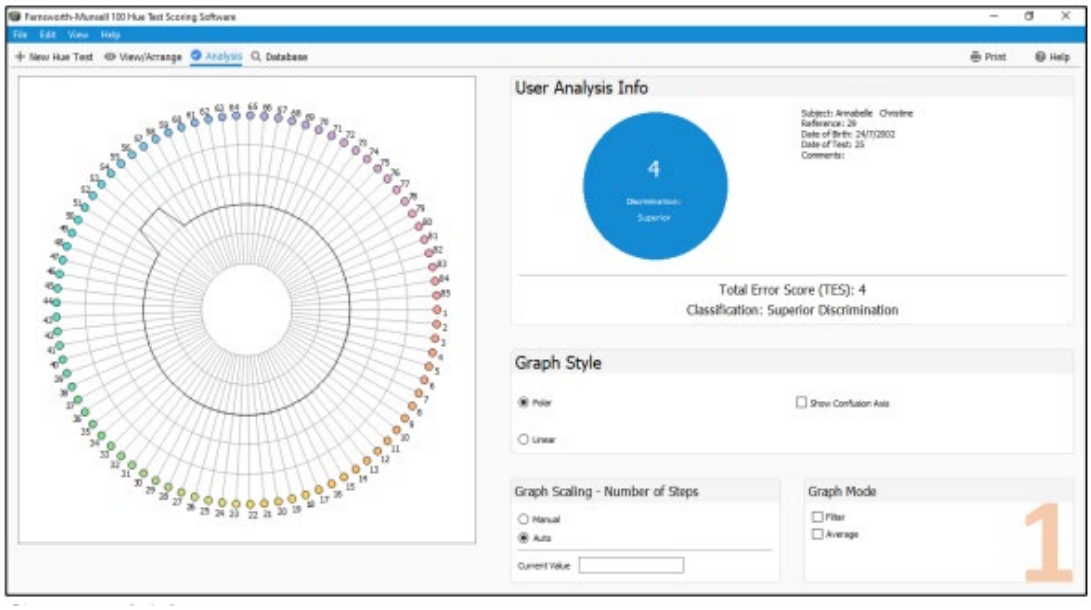

Figure 4. An example polar graph of Superior classification for female participant

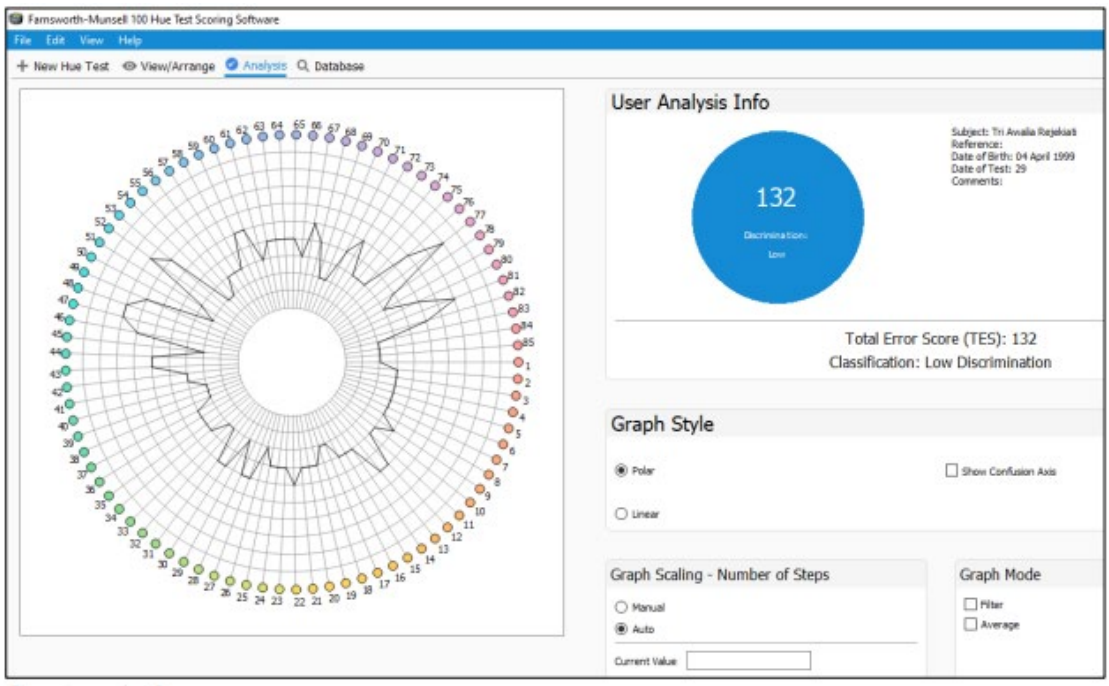

Figure 5. An example polar graph of low classification for female participant

The ability to differentiate or discriminate the colors could be affected by many factors. Among others are demographics and culture, lighting factors, concentration level, age and including gender. According to Varikuti et al. (2020), the prevalence of color vision deficiency (CVD) is about 0.5% in females and 8% in males. The performance of the FM 100 Hue Test also varies with age as younger children mae significantly more misplacement errors than observers in their 20s (Bailao, 2012). In principle for scoring, the closer the participant place the correct sequence, the better is her color discrimination.

Currently, many companies and industries have great need for workers with good characterized and accurate color vision. Among these are design companies, photograpy, motion picture industries, and healthcare system. These companies need workers with superior vision discrimination ability. Considering that the study of color discrimination is still limited and unknown in Indonesia, future studies could be done to involve more subjects with different gender, age groups and occupation.

4. CONCLUSION

In this study, a preliminary survey of the color discrimination test among Indonesian samples has been conducted using the Farnsworth-Munsell (FM) 100 Hue Color Vision Test. The study involved 26 participants of university students and office workers. The results showed that that 19.2% female participants were classified as superior for color discrimination ability. Majority of participants were classified as average (76.9%). Meanwhile for low classification, only 3.9% were classified as low color discrimination ability. Considering the samples, this study involved limited 26 female subjects. Future studies suggest larger scale with more samples from many geographical areas.

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