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Emotional Correlation Test from Binary Gender Perspective using Kansei Engineering Approach on IVML Prototype

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Abstract

This study examines the response of users' feelings from a gender perspective toward interactive video mobile learning (IVML). An IVML prototype was developed for the Android platform allowing users to install and make use of the app for m-learning purposes. This study aims to measure the level of feelings toward the IVML prototype and examine the differences in gender perspectives, identify the most responsive feelings between male, and female users as prominent feelings and measure the correlation between user-friendly feeling traits as an independent variable in accordance with gender attributes. The feelings response could then be extracted from the user experience, user interface, and human-computer interaction based on gender perspectives using the Kansei engineering approach as the measurement method. The statistical results demonstrated the different emotional reactions from a male and female perspective toward the IVML prototype may or may not have a correlation with the user-friendly trait, perhaps having a similar emotional response from one to another.

Index Terms: Emotional Correlation, Binary Gender Perspective, Kansei Engineering Approach, Interactive Video Mobile Learning, Human Computer Interaction

I. INTRODUCTION

Educational videos have been used for many years and are considered to be an effective medium for delivering audio-visual information to learners. Much research has been conducted on educational videos to determine their potential in several fields, including the medical, economic, and scientific fields. As established by Denny, Vahidy, Vu, Sharrief, and Savitz in their study, educational videos are much more effective in increasing knowledge than written materials in ways that could help improve stroke literacy in hospitalized stroke patients [1].

Additionally, interactive video mobile learning (IVML) can be considered as one of the alternative ways to extend the capability and availability of video mobile learning. Cue point interaction features allow learners (users) to have added user control aside from standard interactions, such as using the play, stop, rewind, and forward buttons. Referring to the study reported by Cresswell, Loughlin, Coster, and Green, based on their preliminary evaluation of video-based learning for organic and analytical chemistry, they determined that respondents were looking for interactive learning opportunities based on the way they interacted with educational videos. Their behavior in rewinding, pausing, and reviewing suggested that they were looking for key sections [2]. However, the user response toward interactive educational video was not yet a prominent component of this study—that is, there was not much understanding of the respondents' emotional reaction to specific video styles. Moreover, the learners' learning styles should be considered

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when examining their emotional responses toward different types of videos [3].

Despite that, there are different ways to capture emotion in human-computer interaction (HCI), such as Kansei engineering (KE) and sentiment-specific emotion recognition technologies, depending on the research aims and perspectives. Kansei engineering can examine a user's feelings toward product design features by quantitatively translating their emotional requirements and identifying the connection between them and the product design [4]. Here, sentiment-specific emotional recognition technologies based on sentiment detection are used, followed by the analysis of sentiment expressions under different modalities—such as text, speech, visual, and multimodal displays [5]. Another way to identify emotions and analyze them is through psychological signals, where emotion can be defined using arousal and valence levels as an emotional classifier [6]. However, both sentiment-specific emotion recognition and the use of psychological signals for emotional classification are for HCI system usability and product design rather than establishing emotion correlation. Most studies conducted dealt with user engagements, leaning toward identifying emotions by using eye tracking and electroencephalograms (EEGs), which could be detected as product design satisfaction rather than the correlation of emotional responses. Consequently, this study opted to use the KE approach to analyze the relationship between emotions and product design and measure the correlation strength of relationships from a user-friendliness perspective.

In respect of gender, most research has focused on gender from a female perspective rather than a male perspective; that is, the percentage of the keyword "women" in research titles far exceeds that of "men", leaving the impression that gender matters more to women; this needs to be adequately reflected [7]. Furthermore, HCI, from a gender perspective, has evolved into a complex research topic wherein some researchers have pointed out that the study focuses in HCI should include other genders aside from simply the binary genders of male and female. As mentioned by Keyes, HCI-based studies have been criticized for failing to consider or include a transgender perspective [8].

Although this study focuses on the binary gender, it can be used as future work for those who are interested in exploring transgender perspectives. The aim of this research is to investigate the emotional response derived from the usability of the IVML prototype, compile a checklist of prominent emotions based on the HCI user experience (UX) and user interface (UI) through a pilot test, and identify the emotional response differences between males and females, while at the same time ascertaining any correlation between user-friendly emotion as an independent variable with other feelings as dependent variables. The reason for choosing the user-friendly emotion as an independent variable was because it exemplifies the usability of the UX and UI in product design.

This paper is organized into four sections. **Section II** describes the IVML prototype development and the methods used, including the analytical techniques and approach, KE measurement design framework, and performance metrics. **Section III** describes the results derived from the Kaiser-Meyer-Olkin (KMO) and Bartlett's tests, principal component analysis (PCA), descriptive statistics analysis (Frequency), and Pearson's correlation coefficient (known as Pearson's r). **Section IV** summarizes the discussion and conclusions.

II. IVML PROTOTYPE AND METHODS

It is well-known that multimedia elements—such as audio, graphics, video, text, and animation—can contribute to enhancing the way information is delivered when effectively combined. Video-based collaborative learning can help learners understand concepts based on visualization of the real-world situations that the video provides [9]. Moreover, media diversity plays an important role in helping learners to process information, while less diversity can lead to limitations in understanding the content [10]. By applying HCI design with a touch of UI and UX in educational video mobile learning, one can leverage the media diversity by expanding the number of standard interactive elements, thus, providing increased flexibility in the mobile learning platform.

Consequently, an IVML prototype was developed for the Android platform to broaden the availability of standard interaction elements by providing a cue-point feature allowing leaps between time points in a video timeline for mobile devices such as smart phones. The cue-point feature allowed learners to skip and jump to key sections in an educational video. Aside from adding the cue-point features in the application, the IVML prototype also provided links to YouTube videos and a quiz section to test learners' comprehension of a topic. The IVML prototype application acted as a side note for one subject in the form of audio-visual information, targeting students as users; they could install the application and learn from it before uninstalling it once they were done.

Fig. 1 shows the IVML prototype executed on the Android platform for piloting. The prototype uses basic web programming languages, including hypertext markup language, cascading style sheet, and JavaScript. The video is approximately 10 min duration, the timeline is divided into six targeted cue points representing each of the topics. The HCI design for the IVML prototype focuses on UI and UX usability.

A. Analytical Techniques and Approach

A survey was conducted using a quantitative method to

Fig. 1. IVML Prototype on Android Platform.

obtain the responses of the feelings from users based on the UI and UX. There were 44 respondents in the pilot test wherein 10 feelings data were presented for 22 users per gender. The feelings measurement indicator ranged from 1 to 5 wherein each user could reflect a positive or negative emotion. Three different analysis techniques were used to analyze the feelings data, each analytical technique having its own purpose.

1) Analytical Techniques

The first analytical technique used was the KMO and Bartlett's test, used to analyze the data adequacy, that is, to determine whether the variables were sufficiently acceptable to be analyzed. The second analytical technique was principal component analysis (PCA), used to generate potential emotion factors and extrude the low communalities to reduce unnecessary data. Table 1 summarizes the analytical techniques used in this study.

The third analytical technique used was frequency analysis (or descriptive statistics analysis). This was used to discover the most prominent feelings based on the statistics frequency generated from the data. The fourth analytical technique was Pearson's r, used to measure the bonding strength between two variables. Since the study was based on the UI- and UX-based feelings of respondents, the first variable was chosen to be a user-friendly feeling, the second variable being any of the other nine feelings.

Table 1. The analytical techniques used in this study

Analysis Method	Action
KMO and Bartlett's Test	Sampling the adequacy value of the feelings variable used in the research experiment to verify whether the value is acceptable (in reference to the standard KMO value) before proceeding to the analysis.
Principal Component Analysis (PCA)	PCA extraction method to extrude the low communalities feelings from analysis and protrude the potential emotion factor. This feelings reduction can be done through feelings extraction.
Descriptive Statistics Analysis (Frequency)	Identify the most common feelings that respond toward UI and UX design of IVML prototype on both genders.
Pearson's r	Understanding the strength between the feeling of user-friendly and other feelings variables.

2) Analytical Approach

The analytical approach for this study comprised the conceptual design, video production style, KE measurement, and affective value processes to measure the production value enrichment. The conceptual design was the initial step in developing the video material—including the development of creative ideas and modules—after which the video production style was derived from the development concept and educational quality required. The KE method was used to determine the significance of the affective values. In this case, the study was narrowed down to focus on the correlation strength between the IVML prototype and user feelings based on their gender attributes to observe the potential for improving the teaching and learning quality of video learning which could lead to the enrichment of the production value. Fig. 2 shows the analytical model.

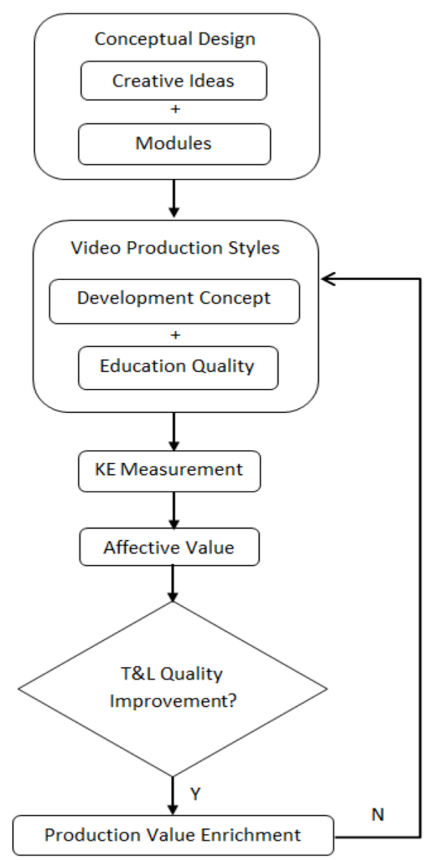

Fig. 2. IVML Prototype on Android Platform.

B. KE Measurement Design Framework

A framework was designed to execute the emotion treatment using the KE measurements. As shown in Fig. 3, the steps begin with data collection, consisting of feelings variables, respondents, and a product sample. A pilot test was conducted based on these data wherein 44 users (22 males and 22 females) tested the IVML prototype. A questionnaire was given to them after the pilot test to capture their feelings, the data of which were then analyzed to obtain an adequacy value of the feelings variable before the next analysis began.

The data derived from the feelings, respondents, and product sample then went through KMO factor analysis for adequacy sampling before proceeding to PCA extraction to extrude the low communality variables for data reduction and protrude the high communalities. The method proposed for this treatment can be used to verify whether the feelings variable presented is suitable for analysis.

These feelings variables can then be used for descriptive statistics analysis to identify the most responsive feelings based on the statistics data frequency and to assess the value of the mean acquired from the rating scales and respondents. The method proposed can then be used to classify the reactive emotion occurrence based on the statistical data.

Next, the Pearson correlation coefficient, or r-value, can be obtained. If the r-value is close to 1 and the number is positive, the correlation strength between the two variables is strong, having a parallel increment and decrement. However, if the r-value is close to 0 and negative, the correlation strength between the two variables is weak, having a contrasting increment and decrement. The proposed method can then be used to verify the possibility of interrelationships between the feeling variables produced to accentuate the significance of applying the HCI notion in video-based learning for user engagement derived from affective perception.

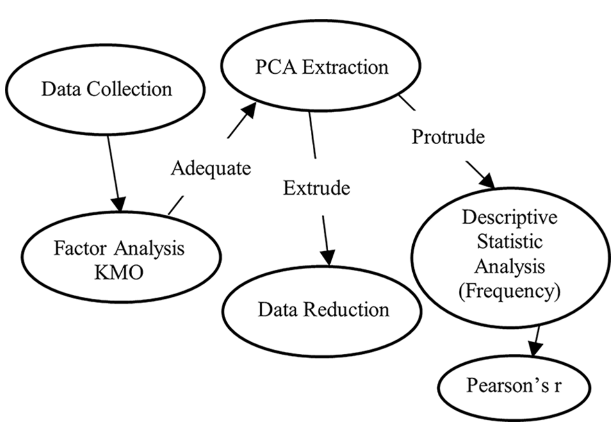

Fig. 3. IVML Prototype on Android Platform.

C. Performance Metrics

The mean value in descriptive statistics analysis (frequency analysis) expresses the average number of the feeling's rating scale. The mean value can be obtained from the total rating scale and total respondents, as in (1).

$$\frac{\text{Total Rating Scale}}{\text{Total Respondents}} = \text{Mean Value } (\mathcal{N}) \tag{1}$$

The above formula and the interpretation of $\mathcal{N}$ as a mean value in respondents' feelings can be expressed as follows:

<u>Example of Data Collection:</u>
Total Respondents = 5
<u>Students Rating Scale:</u>
Positive = 5, *Almost Positive* = 4, *Moderate* = 3,
Less Negative = 2, *Negative* = 1
<u>Example of Situation:</u>
Respondent A feels *Negative*, Student B feels *Moderate*, Student C feels *Positive*, Student D feels Less *Negative*, and Student E feels *Almost Positive*. Thus, the conditions are Student A = 1, Student B = 3, Student C = 5, Student D = 2, and Student E = 4.

For the above case, $\mathcal{N}$ becomes, as shown in (2).

$$\mathcal{N} = \frac{1+3+5+2+4}{5} = \frac{15}{5} = 3\,, \tag{2}$$

if $\mathcal{N}$ = 3, then $\mathcal{N}$ is moderate, and the average feelings of students are moderate.

III. RESULTS

A. The KMO and Bartlett's Test

The KMO and Bartlett's test was conducted on 44 students, whereby these students were divided into two groups based on their gender. The treatment was conducted for each group, as shown in Table 2.

The values between 0.50 and 0.70, 0.70 and 0.80, 0.80 and 0.90, and 0.90 and above are considered to be average, good, great, and excellent, respectively. Moreover, the KMO and Bartlett's test significance must be less than 0.05 for cor-

Table 2. KMO and Bartlett's Test for Male and Female Groups

Male	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	658
Sig.	.000
Female	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.557
Sig.	.000

Table 3. Principal Component Analysis (PCA) for Male and Female Groups

	Male	
	Initial	Extraction
Appealing	1.000	.767
Boring	1.000	.665
Convenient	1.000	.734
Creative	1.000	.686i
Fun	1.000	.589
Interesting	1.000	.816
Necessary	1.000	.608
Refreshing	1.000	.899
Satisfied	1.000	.605
User-Friendly	1.000	.840
	Female	
	Initial	Extraction
Appealing	1.000	.858
Boring	1.000	.879
Convenient	1.000	.861
Creative	1.000	.825
Fun	1.000	.835
Interesting	1.000	.734
Necessary	1.000	.714
Refreshing	1.000	.830
Satisfied	1.000	.814
User-Friendly	1.000	.882

related variables to have occurred. Consequently, factor analysis is appropriate for these data.

B. Principal Component Analysis (PCA)

The communalities range is from 0-1, where 0 means there is no variance and 1 means there is high variance. If the number is less than 0.5, it can be considered to have low communality and should be removed from the analysis. However, the PCA variables for both genders are relatively high, which is indicative of a good result.

C. Descriptive Statistics Analysis (Frequency)

Table 4 shows the IVML prototype descriptive statistics analysis (frequency analysis) results for male and female users. Based on the results, it is evident that the IVML prototype manages to stimulate positive feelings from both genders except for feeling convenient to the male group and feeling appealing to the female group, where the result for both groups is neutral. For instance, referring to the performance metrics, the mean formula for the "feeling interesting" type of feeling for males (Table 4) can be expressed as 98/22 = 4.45, where 98 denotes the total rating scale, 22 denotes the total respondents, and 4.45 denotes the mean value of the performance metric. The 4.45 mean value confirms the "interesting" feeling perception for male respondents; moreover, a similar result is evident for female respondents. Mean values above 3.50 or below 3.00 for each feeling represent strong total rating scale inclinations from the respondents. Consequently, the mean value projected for both groups shows a strong inclination to each respective feeling.

Table 4. Descriptive Statistics Analysis (Frequency) for Male and Female Groups

		Male		
Types of Feelings	Level	Frequency	Total Rating Scales	Mean Value
Appealing	Almost Appealing	8	79	3.59
Boring	Not Boring	9	50	2.27
Convenient	Neutral	7	78	3.55
Creative	Creative	10	94	4.27
Fun	Almost Fun	9	94	4.27
Interesting	Interesting	13	98	4.45
Necessary	Almost Necessary	9	80	3.64
Refreshing	Almost Refreshing	8	82	3.73
Satisfied	Almost Satisfied	8	81	3.68
User-Friendly	User-Friendly	9	86	3.91
		Female		
Types of Feelings	Level	Frequency	Total Rating Scales	Mean Value
Appealing	Neutral	8	77	3.5
Boring	Not Boring	11	46	2.09
Convenient	Almost Convenient	7	79	3.59
Creative	Creative	11	97	4.41
Fun	Fun	10	91	4.14
Interesting	Interesting	12	96	4.36
Necessary	Almost Necessary	8	87	3.95
Refreshing	Refreshing	10	86	3.91
Satisfied	Almost Satisfied	8	83	3.77
User-Friendly	User-Friendly	10	93	4.23

D. Pearson's r

Pearson's r was used to measure the correlation strength between the "user-friendly" feeling as an independent variable and the other nine feelings as dependent variables. Bivariate analysis was conducted for both male and female respondents to compare the variables' strengths. It should be noted that the abbreviations for Table 5 are as follows:

A = Appealing, B = Boring, C = Convenient, Cr = Creative, F = Fun, I = Interesting, N = Necessary, R = Refreshing, S = Satisfied, and *UF = User-Friendly*

With reference to Table 5, the correlation strength for male

Table 5. Pearson's r for Male and Female Respondents Correlations Strength

(a) Male Respondents Correlations Strength										
Male		A	B	C	Cr	F	I	N	R	S
User-Friendly	Pearson Correlation	.741**	-.532*	.318	.578**	.444*	.443*	.754**	.792**	.354
	Sig. (2-tailed)	.000	.011	.150	.005	.038	.039	.000	.000	.106
	N	22	22	22	22	22	22	22	22	22

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

(b) Female Respondents Correlations Strength										
Female		A	B	C	Cr	F	I	N	R	S
User-Friendly	Pearson Correlation	.208	-.729**	.281	.217	.263	.473*	.557**	.535*	-.034
	Sig. (2-tailed)	.352	.000	.205	.332	.237	.026	.007	.010	.879
	N	22	22	22	22	22	22	22	22	22

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

respondents between "user-friendly" as an independent variable and "appealing", "necessary", and "refreshing" as dependent variables shows a strong positive bonding. The "user-friendly" and "appealing" variables show $r = 0.741^{**}$, n = 22, and p = 0.000; the "user-friendly" and "necessary" variables show $r = 0.754^{**}$, n = 22, and p = 0.00; and the "user-friendly" and "refreshing" variables show $r = 0.792^{**}$, n = 22, and p = 0.000. The correlation strength for female respondents shows that the "user-friendly" and "boring" has a strong negative correlation between them; that is, the "user-friendly" and "boring" variables show $r = -0.729^{**}$, n = 22, and p = 0.000. The "boring" feeling is the prominent emotion having the most impact on female respondents.

IV. DISCUSSION AND CONCLUSIONS

The IVML prototype pilot test was conducted to evaluate the feelings response from respondents toward the usability of HCIs in the product design of the IVML prototype from UI and UX design perspectives. Based on the positive feelings' reactions from both genders, it is evident that the IVML prototype product design was capable of leaving an impression of not being a boring application, but being a creative product design, of being interesting to use for mobile learning, of being almost necessary to have, of almost satisfying the need for video mobile learning, and of being user-friendly—mutual feelings shared by both genders.

Nonetheless, there were still differences in the feeling response of both genders—such as feelings of appeal and convenience. From the male users' perspective, the IVML prototype product design was almost appealing, almost fun to use, and refreshing to them, but when it came to being convenient, they felt neutral. From the female users' standpoint, however, the appeal of the IVML prototype was seen to be neutral, although they did find the application to be almost convenient, fun, and refreshing for them.

Aside from that, there were major differences in correlation strength for the feeling of "user-friendly" with the other affected feelings, such as "appealing," "necessary," and "refreshing." The study showed that the male respondents had a strong and positive correlation for "user-friendly" with the aforementioned feelings, whereby the r-value was closer to 1, that is, the deviations in "user-friendly" as the independent variable could change the perspective of "appealing", "necessary", and "refreshing" as the dependent variables for male respondents. The r values for the three dependent variables were also positive, indicating that an increase of "user-friendly" feelings would also increase the other three dependent variables, the p-value showing there to be a significant correlation between them.

By contrast, the female respondents produced a different outcome whereby the feelings of "user-friendly" as an independent variable only affected the "boring" feelings as a dependent variable. Although the r-value was close to 1, the bond between these two variables exhibited a negative correlation. The results showed that the higher the "user-friendly" feeling, the less bored they were with the apps. The p-value for this feeling exhibits that there is a significant correlation between these two variables.

Consequently, it is evident that the IVML prototype could induce positive feeling responses from both genders in which both groups of respondents had practically mutual responses toward this type of product design. Moreover, adding the cue-point feature as hyperlinks for key sections in the video produced a strong correlation for the "user-friendly" media trait for both genders.

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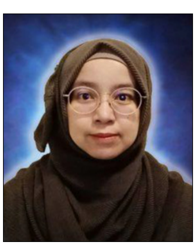

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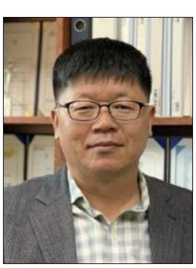

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