Chapter 7

Analysis Learners' Preference in E-Learning System Using Kansei Approach

Ana Hadiana

Additional information is available at the end of the chapter

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Abstract

Academic institutions have opportunity to provide better learning environment over the Internet using open source web-based e-Learning systems. One of the important issues is how to choose a suitable e-Learning system that can meet what learners need implicitly. It lacks guide to support academic institutions in determining a proper e-Learning system based on learners' needs; it becomes the reason of the implementation of e-Learning that cannot work for long time. This chapter gives an information of result observation regarding learners' psychological aspects toward e-Learning system using Kansei Engineering and its correlation with the e-Learning interface design. Analyzing learner's preference related to e-Learning system, it can provide the kind of desired e-Learning system to enhance learners' experience; finally, it can help the academic institutions to implement e-Learning system continually for a long time.

Keywords: e-Learning, learners' preference, emotion, design elements, Kansei engineering, multivariate analysis

1. Introduction

E-Learning is a kind of web-based system to support learning using computer network as one of learning media via the intranet/Internet. Many web developers compete to develop different kinds of e-Learning systems. Almost all these systems are generally developed based on ambiguous specification of interface's design, mostly ignored the importance of providing desired e-Learning system that can match with learners' implicit needs or desires. Existing open source e-Learning systems are generally developed not for specific learners; it is important to revise the system for specific learners based on specific academic institution.

There are little e-Learning system design guides to observe a system that can maximally meet learners' expectations.

Usability is one factor to be considered in designing e-Learning system interface [1]. Besides its usability, it is also important to pay attention on aspect of usefulness and functionality [2]. A knowhow to design more persuasive learning interface is one of the critical points. E-Learning system developments are lacking consideration of psychological factors, which includes expressing learners' emotions. This study focuses on observing learners' psychological factors because most of users of e-Learning system are learners.

Kansei engineering has been widely referred to explore the emotions in many kinds of product design including software. This study uses Kansei engineering approach in its investigation of learners' emotion due to its ability to translate user's psychological feeling into a concept of emotion, which the research proposed to be incorporated into web-based e-Learning system design.

Many studies have been performed adopting Kansei engineering in many fields for product development including software or computer applications. For example, it includes emotion and entertainment in [3, 4], emotion and wheel chair in [5], emotion and e-commerce in [6, 7], emotion and textile in [8, 9], and emotion and fashion design in [10]. However, there are only few studies that report about learners' emotion in the education domain.

Figure 1 describes the basic idea of Kansei engineering which explains recommendations of solution as product design based on what user's feeling. The founder of Kansei Engineering, Mitsuo Nagamachi, Professor Emeritus of Hiroshima University, defines Kansei as a state of mind, that is, psychological feeling and needs in mind [11]. Kansei is referred to the state of mind where knowledge, emotion, and passion are harmonized [12]. Kansei engineering is established as a discipline that successfully assimilates Kansei, psychology, engineering, and statistics [13]. Kansei engineering is intended to improve product development to win users' heart and mind. It has in its methodology a systematic process to discover users' insight responses toward product display via several physiological and psychological assessment methods. This knowledge will then be translated into product design specifications, which formulate a new product design based on user's implicit emotional feelings and

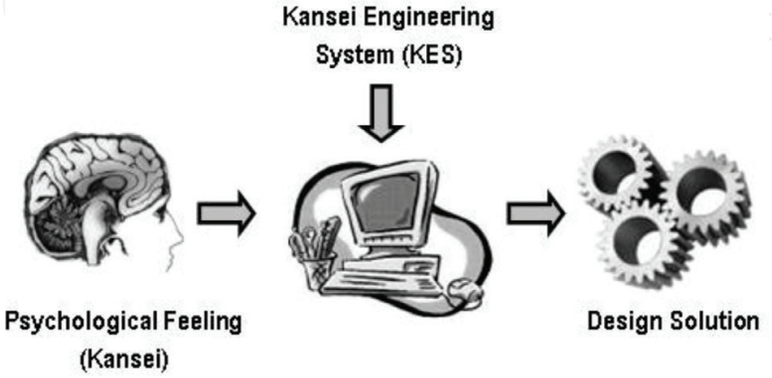

Figure 1. Principle of Kansei engineering [11].

desires. In the case of e-Learning system, this methodology can be used to enable inclusion of learners' emotion, as positive emotion has been found to positively associate with learning activities [14, 15].

Figure 2 shows the diversity of users' expressions that can be used as psychological measurement in Kansei Engineering in Kansei Engineering. Eye movement, face expression, word, etc., can be used as gateway of users' emotions to be analyzed. There are many alternative choices to be used to gain users' emotions related to a product. In many studies of Kansei engineering, Kansei words are used as variable in evaluation and analysis to represent user's emotion related to product. A sample of product used in Kansei engineering is named as specimen.

Implementation of Kansei engineering in education's domain started to appear in the end of the 2000s. In e-Learning system almost all the users are students or learners. Kansei research in this kind of domain mainly focused on learners. Study in [16] explains the element of colors on e-Learning web interface, in the effort to enhance experience. Study in [17] reports the aspect of emotion in interactive e-Learning system with the use of biometric signal and Kansei engineering, by analyzing knowledge and emotion level. Study in [18] proposes a conceptual model for e-Learning using a software agent to recognize and respond to the learners' emotional state during learning phase. Other studies of Kansei engineering in e-Learning can be found in [19] which reports about Kansei semantic space in online database courseware systems and [20] which reports a theoretical framework of playful interaction in mobile learning system. Chen [21], Hussin and Lokman [22], and Lokman [23] are other studies of Kansei engineering to design an interface of web-based system development.

The aim of this study is to observe the relationships between learners' emotional factors (psychological feeling) and the interface design of web-based e-Learning system. The result of this research could be used as guide in ensuring that a selected e-Learning system has a desired interface and function that suit to learners' psychological requirement. This study especially puts its focus of investigation to open source learning management system to be used as

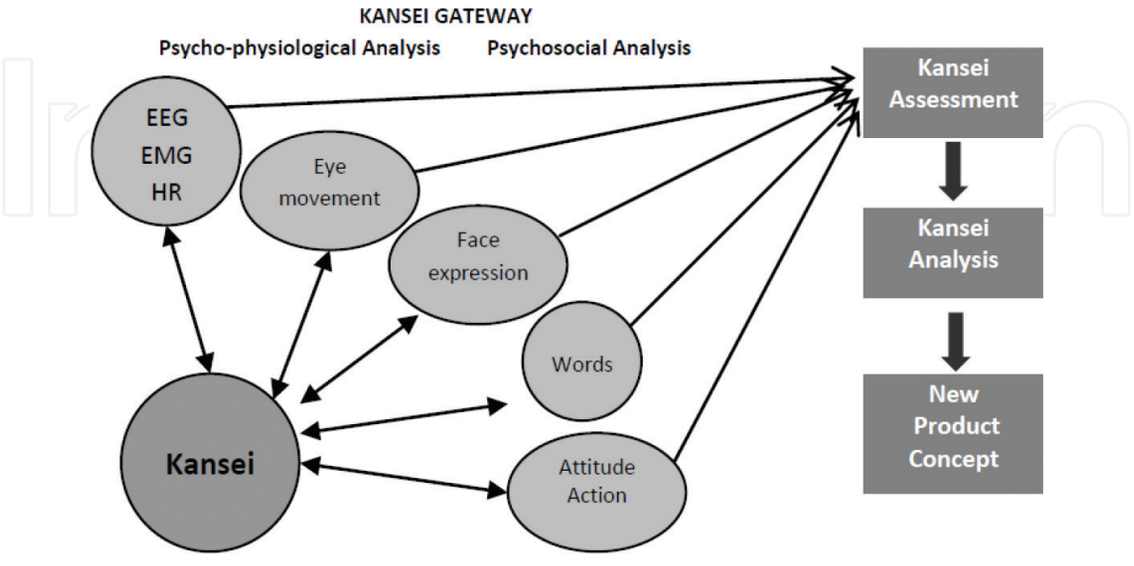

Figure 2. Kansei gateway [6].

platform of e-Learning system in higher educational institution. This study mainly analyzes learners' experience on the e-Learning and translation of emotion to e-Learning interface.

2. E-Learning system

E-Learning is a learning model that involves information and communication technology into learning activities. Better learning process will be gained without changing conventional learning model. E-Learning plays important role in learning, because it provides learning tools to support learning process optimally, but it is not to replace totally the conventional learning.

Nowadays, according to the growth of information technology, many education institutions such as high education try to implement e-Learning to provide better learning environment based on information technology, to give better service of learning activities. E-Learning will support conventional learning by applying information technology, in order to improve learners' learning performance and learning experiences to get more valuable knowledge.

Another name of e-Learning is virtual learning, and in general it can be divided into two types as follows:

- Synchronous system. All learners are required to participate on learning process in the same time and are provided by tool to collaborate with other learners simultaneously. It will impact on improvement of knowledge achievement during learning.
- Asynchronous system. In this case all learners are given flexible time to access the system due to each phase or condition of learning. Learners are provided to be able to communicate with each other using collaboration tools such as bulletin board system.

Most of e-Learning systems either open source or proprietary are generally web-based system and have similar functions or have standard functions to support learning process effectively and efficiently through the Internet. It is possible for education institution to analyze and select the best one to be implemented in their institution. In e-Learning system, the important thing is not only learning functions; learning environment is also an important thing such as interface which acts as link between learners and system. Interface plays a key role in making learners' motivation of using e-Learning for a long time with pleasure and without depression.

The interface's body of web-based e-Learning system commonly is similar to common web-based information system. Basically, it should consist of many design elements as follows:

- Header and footer
- Background (logo and color)
- Font (type, size, and color)
- Menu (position, type, and style)

This study attempts to observe the relationship between design elements and learners' emotion. In other words, using Kansei engineering it will translate the learners' emotion into e-Learning system design elements; then learner-oriented interface can be proposed.

3. KEPack

This study adopts method of Kansei Engineering Type I (KEPack) due to its simplicity and wide use in many product developments [2, 6, 10, 19, 20, 22, 23]. **Figure 3** shows the systematic processes of KEPack. This study uses KEPack as methodology to process the inputted data from learners about what they emotionally feel after exploring each the interface of e-Learning system.

At least five open source e-Learning systems [24–28] can be selected as specimens based on its suitability to be adopted in the academic institution's environment, to be used as specimen in the Kansei evaluation session. The specimens are selected based on their visible differences in design characteristics such as background color and page layout. The selected five specimens in this study are Moodle, Efront, Opigno, Chamilo, and ATutor. Ten Kansei words representing psychological feeling are selected to represent psychological responses learners have with the specimens. The Kansei words are as shown in **Table 1**. This study constructs each Kansei words to five-point semantic differential (SD) scale to be used as measurement instrument in the Kansei evaluation session. In this study one hundred learners are involved as participants. Participants consist of first-grade university students. For further analysis data collection can be categorized according to gender, age, and so on. Learners are required to give responses

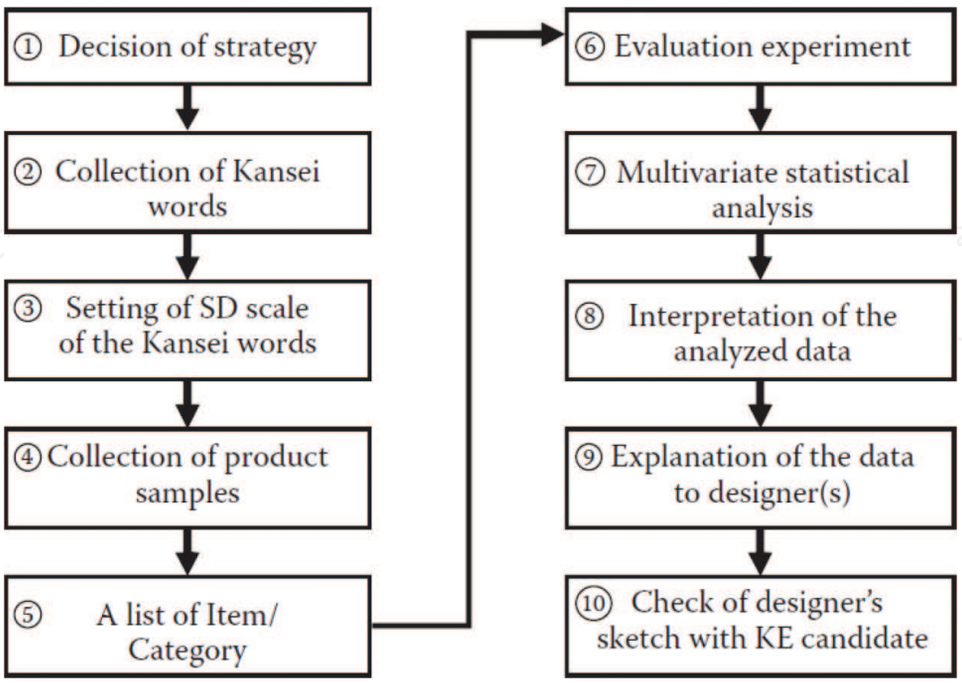

Figure 3. KEPack methodology [11].

No.	Kansei words	Specimens				
		Moodle	Efront	Opigno	Chamilo	ATutor
1	Dynamic					
2	Informative					
3	Simple					
4	Bright					
5	Harmony					
6	Comfort					
7	Rigid					
8	Unique					
9	Passion					
10	Formal					

Table 1. Questionnaire using Kansei words and five-point scale semantic differential.

toward the specimens of e-Learning system. Each specimen is shown for a limited time one by one in an experimental room; all participants rate their Kansei responses to fill the score (from 1 to 5) of every Kansei word into the Kansei checklist.

Multivariate analysis is performed to analyze the average data obtained from the evaluation session. Existing software statistic such as XLStat or SPSS can be used for calculating questionnaire data. Finally, this study provides a recommendation of the desired open source e-Learning system to be used in supporting learning process.

3.1. Data collection

In this study, questionnaire data from all participants are collected and then calculated its average as shown in **Table 2**.

The data is analyzed by two kinds of multivariate analysis: principal component analysis for analyzing distribution of Kansei words and specimens and factor analysis for exploring the biggest emotion.

3.2. Coefficient correlation analysis

The relationship between emotions represented by Kansei words is shown in **Table 3**. According to this result, Kansei word relationship can be divided into six categories such as very strong, strong, enough, weak, very weak, and no relationship. For example, the emotion of bright has strong relationship with the emotion of dynamic, but has no relationship with simple.

3.3. Principal component analysis

Table 4 and **Figure 4** show the result of principal component analysis. According to data collection, there are many factors that have significant impact to the specimens. It provides evidence

No.	Kansei words	Specimens				
		1	2	3	4	5
1	Dynamic	3.02	2.85	3.04	3.09	3.15
2	Informative	3.1	3.3	3.4	3.29	2.9
3	Simple	2.98	3.14	3.05	2.96	3.01
4	Bright	2.96	2.84	3.02	3.02	3.14
5	Harmony	2.91	2.83	2.9	3.01	3.27
6	Comfort	3.14	2.74	3.06	3.17	3.03
7	Rigid	3.21	3.03	3.0	2.79	2.9
8	Unique	3.13	3.2	2.81	2.85	3.08
9	Passion	3.13	2.93	2.92	2.73	3.01
10	Formal	3.03	3.0	3.03	2.98	2.91

Table 2. Average data from all participants.

Kansei words	Dynamic	Informative	Bright	Harmony	Comfort	Rigid	Simple	Unique	Passion	Formal
Dynamic	1	−0.510	0.967	0.819	0.778	−0.456	−0.802	−0.493	−0.068	−0.539
Informative		1	−0.557	−0.790	−0.158	−0.057	0.348	−0.494	−0.549	0.714
Bright			1	0.885	0.609	−0.464	−0.626	−0.429	−0.011	−0.639
Harmony				1	0.320	−0.502	−0.458	−0.046	0.037	−0.909
Comfort					1	−0.141	−0.958	−0.592	−0.062	0.038
Rigid						1	0.210	0.530	0.840	0.606
Simple							1	0.419	0.056	0.156
Unique								1	0.623	−0.154
Passion									1	0.111
Formal										1

Table 3. Kansei word relationship.

of the variability for each D1 to D4. The level of variability of D1 is 47.771%; D2 is 29.407%, respectively. The total cumulative value of D1 and D2 is 77.178% more than threshold value of 70%. It means that these two factors of D1 and D2 can be used for further analysis because these factors have enough influence for representing learners' emotions toward the five open source e-Learning systems.

Figure 5 shows the result of analysis using principal component vector (PCV) analysis. PCV is used to visualize direction and strength of emotion over the structure of emotion, to determine Kansei area [6]. It shows the distribution of e-Learning systems according to learners'

	D1	D2	D3	D4
Variability (%)	47.771	29.407	18.679	4.143
Cumulative (%)	47.771	77.178	95.857	100.000

Table 4. Percentage of variance.

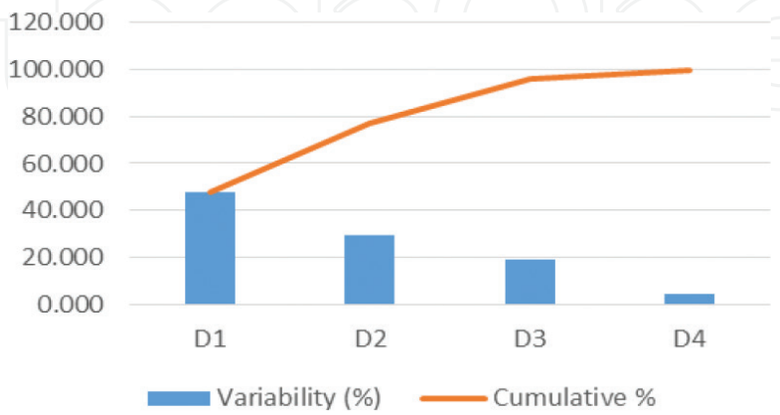

Figure 4. Factors from principal component analysis.

emotions. Evidence showed in **Figure 5** that specimen ATutor, which is found residing in the positive x and y axes, is nearest to emotion of harmony. On the other hand, Chamilo is somewhat near to emotion of comfort, Opigno is near to emotion of informative, Efront is near to emotion of simple, and Moodle is mostly near to rigid.

3.4. Factor analysis

This analysis is to refine the result of principal component analysis. Varimax rotation is used in this analysis to generate more accurate result. **Table 5** shows the result of this analysis. There are two factors with contribution level, respectively, with Factor 1 of 46.838% and Factor 2 of 29.050%. This means that Factor 1 has the highest score of contribution. In cumulative percentage, Factor 1 and Factor 2 have represented 75.889% of total contribution. Analysis using these two factors is conducted to determine the coefficient of emotion and generate variability scores for each 10 Kansei words, as shown in **Tables 6** and **7**.

The factor scores shown in **Tables 6** and **7** are sorted in ascending order to determine the influence of emotion in e-Learning system. The research set the reference threshold to 0.8. Based on Factor 1, the emotions that have score of more than 0.8 are bright, dynamic, and harmony. Based on Factor 2, there is only the emotion of unique. Factor 1 and Factor 2 are represented by the emotion of harmony and the emotion of unique, respectively. The emotion that has biggest impact is harmony. Other emotions shown in **Tables 6** and **7** have value lower than 0.8, and thus it can be ignored because they have less influence to emotion in the selected open source e-Learning systems.

According to this result, it can be concluded that the emotion has influence to preferred system. The emotion or psychological aspect should be considered in selecting the open source

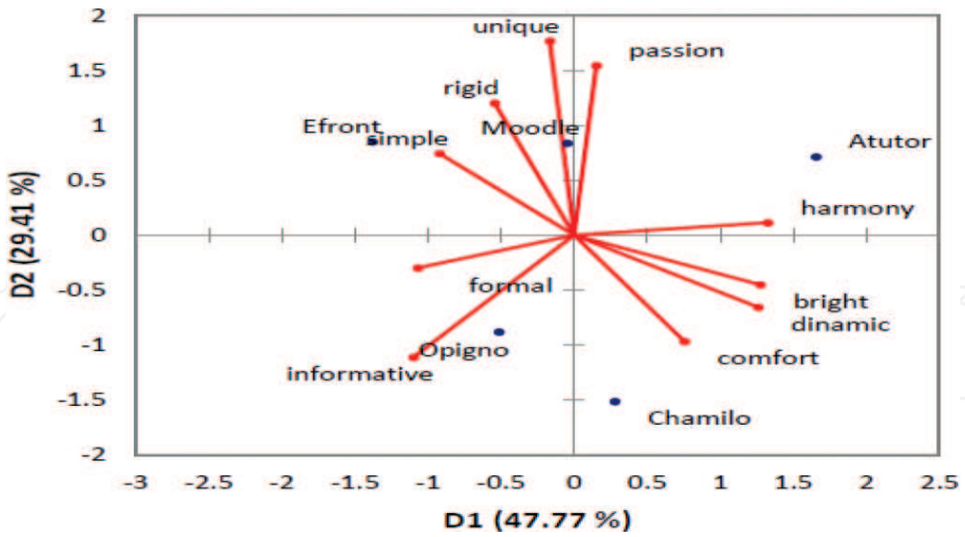

Figure 5. Principal component vector.

	Factor 1	Factor 2
Variability (%)	46.838	29.050
Cumulative (%)	46.838	75.889

Table 5. Factor analysis.

Kansei words	Factor 1
Informative	−0.819
Formal	−0.787
Simple	−0.628
Rigid	−0.376
Unique	−0.093
Passion	0.128
Comfort	0.527
Bright	0.896
Dynamic	0.903
Harmony	0.968

Table 6. Emotion impact priority based on Factor 1.

e-Learning system which is harmony and as alternative emotions which are unique, dynamic, and bright. Academic institution should recommend developer to give full attention to these emotions when designing interface of e-Learning system.

Kansei words	Factor 2
Informative	−0.570
Comfort	−0.540
Dynamic	−0.385
Bright	−0.270
Formal	−0.136
Harmony	0.028
Simple	0.402
Rigid	0.658
Passion	0.795
Unique	0.907

Table 7. Emotion impact priority based on Factor 2.

3.5. Partial least square

The evaluation using partial least square needs two kinds of data such as average data of questionnaire and all specimens' design elements. As shown in **Table 8**, data of design elements consists of each specimen's design elements in a form of table with value of 0 and 1; if a specimen has the element, it will be set as 1; if a specimen has no element, it will be set 0.

Partial least square combines these two kinds of data to generate data of design elements based on learners' emotion as shown in **Table 9**. Comprehensive investigation can be implemented in order to determine link between emotion and design elements.

The results of this analysis are what kind of design elements should be considered when designing interface of e-Learning based on learners' emotion. The biggest emotion evaluated by factor analysis will be the critical point of design elements to be considered. In this case, factor analysis's result shows that the emotion of harmony has greatest impact in designing an interface of e-Learning.

No.	Kansei words	BGColorWhite	BGColorGray	BodyFont10	BodyFont12	HeaderColorWhite	…
1	Moodle	1	0	0	1	1	…
2	Efront	0	1	0	1	1	…
3	Opigno	0	1	0	1	0	…
4	Chamilo	1	0	1	0	1	…
5	ATutor	1	0	0	1	1	…

Table 8. Design elements of specimens.

Variable	Coefficient	Range	Impact
BGColorWhite	−0.0974		
BGColorGray	0.0974	0.1948	√
BodyFont10	0.0482		
BodyFont12	−0.0482	0.0964	√
BodyFontArial	0.0050		
BodyFontCalibri	−0.0050	0.0100	–
HeaderColorWhite	−0.0050		
HeaderColorGray	0.0349		
HeaderColorGreen	0.0424		
HeaderColorBlack	−0.0712	0.1136	√
HeaderLogoOK	0.0000	0.0000	–
HeaderImgOK	0.0050	0.0050	–
TopMenuBGColGreen	−0.0482		
TopMenuBGColGray	−0.0296		
TopMenuBGColWhite	0.0000		
TopMenuBGColBlack	0.0424	0.0906	–
TopMenuFontSmall	0.0424		
TopMenuFontMedium	−0.0689	0.1113	√
TopMenuAboveHeader	0.0424		
TopMenuBelowHeader	−0.0689	0.1113	√
BodyMenuRight	−0.0238		
BodyMenuLeft	−0.0628		
BodyMenuCenter	0.0349	0.0977	√
BodyMenuText	−0.0974		
BodyMenuIcon	0.0974	0.1948	√
BodyMenuTextSmall	−0.0349		
BodyMenuTextMedium	0.0349	0.0698	–
SearchBarAsLink	−0.0235		
SearchBarAsTextbox	0.0628	0.0863	–
SearchBarAtTopCenter	−0.0712		
SearchBarAtTopRight	0.0974	0.1686	√
Average of range		0.0964	

Table 9. The impact of design elements.

3.6. Recommendation of design elements

For further analysis to support interface design, it needs to calculate the importance of each design element, using procedure as follows [12]:

i. Calculate the range of each category of elements

ii. Calculate the average of all ranges

iii. Compare the average with each range of category; if range of category is bigger than the average, it means that the element of this category has high impacts on interface design. Otherwise, the category has low impact.

According to the result shown in **Table 9**, the emotion of harmony-based design elements of interface of e-Learning is focused on element that has high impact. E-Learning's interface is recommended as follows:

i. Background color: gray

ii. Font type: Arial

iii. Font size: 10px

iv. Header background color: green

v. Header has an image

vi. Top menu font: small

vii. Top menu position: above header

viii. Body menu position: center

ix. Body menu type: icon

x. Search bar position: top right

Other elements which have low impact are still considered as alternative design element; it can be changed with different values.

4. Conclusion

This chapter explores the potential of Kansei engineering implementation in e-Learning analysis and design. E-Learning development is lacking in terms of defining the emotional aspects for design. Thus, this chapter has attempted to engineer emotion in e-Learning system design to fill in the gap of design requirements geared to learners' emotional responses.

Kansei engineering has been adopted to analyze learners' psychological needs and desire in an e-Learning system. In this study, psychological factors are represented by Kansei words to classify them into the concept of emotion in e-Learning systems. Using principal component analysis, factor analysis, and partial least square, this study finds that harmony is the emotion that has the highest influence to the design concept of interface of e-Learning systems.

The proposed method in this study can be used for more specific object, for example, the content of learning material, in order to provide the proper learning material based on learners' psychological aspects.

Further study is proposed to investigate e-Learning system using Kansei engineering based on wider population and demography, to investigate e-Learning interface design elements in more detail. It is critical to explore design element more detail in order to enhance open source platform of e-Learning system based on learners' emotion.

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Author details

Ana Hadiana

Address all correspondence to: anahadiana68@gmail.com

Research Center for Informatics (P2I)-LIPI, STMIK-LIKMI, Bandung, Indonesia

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