

# Emotional Preferences Towards E-Learning Based on Analytic Hierarchy Process and Kansei for Decision Making

Ana Hadiana

**Abstract** — Users in software world play key role in determining whether a software, including e-Learning system, has a long time of use or not. Past literatures have highlighted the importance of incorporating emotional requirement into software systems. It is important to consider what users need related to software. One of the critical component of a software systems that directly interacts with users is the interface. Users interface design (UID) could induce critical emotional experience and impression to users the first time they execute a software system. Kansei Engineering is adopted as a methodology to analyze users emotional experience towards the software UID. This research implemented a combination approach of Kansei Engineering and Analytic Hierarchy Process in order to analyze students' emotional experience as users of e-Learning in higher learning institution, and then determines which of an open source e-Learning system that suits their positive emotional experience. This paper reports an attempt to discover the relationship between UID and users' emotional experience in e-Learning systems. The research found that there were two critical students' emotional factors, which are "clear" and "pleasant". These two factors had a big impact in the selection of an e-Learning system, with factor of clear has larger impact. The research result then suggests the preferred e-Learning system for students based on those that evoked positive emotional experience to students. The result will benefit higher learning institution in promoting e-Learning, to extend the outreach potential of e-Learning among students.

**Index Terms** — Kansei Engineering, Emotional experience, AHP, UID.

## I. INTRODUCTION

E-Learning system in educational institution plays an important role in providing better learning environment over internet, because of its potential to support students' learning activities and ultimately enhance their learning performance [1, 2].

Today, abundance of open source and proprietary e-Learning systems exist. In general, most of them are similar to each other and have standard functions required to conduct learning activities via internet. It has become harder to determine which ones are appealing and bring positive experience to students., as positive experience appears to be the first phase to success of any electronic or online systems. This has forced educational institution to find the best mechanism to assess, analyze, and finally select the most suitable one/s to be implemented. It has become a critical

matter for education institution, as the implementation of e-Learning system needs to be tailored to students' implicit requirements.

Software requirements consist of functional aspect and emotional aspect. However, emotional aspect lacks developer's attention, and e-Learning design and development mostly focuses on functional requirements. Considering about implementation of e-Learning system based on students' emotional preferences is important to ensure what they need implicitly [3]-[5], and it could encourage the students to enjoy the system, and gather more knowledge during learning.

Nowadays, there have been many kinds of e-Learning system, and all of them functionally have the same facilities for learning such as material learning management, discussion, task management, and so forth. It needs a decision method to determine the suitable e-Learning system for students based on their emotional feeling toward the e-Learning system through its interface.

Kansei Engineering has been widely used in the research of product development including software due to psychological aspects or emotional factors [6], [7]. Kansei Engineering has an ability to describe users' emotional feeling into an emotional concept of software including e-Learning system [8].

The goal of software design is to make a product that can be understandable easily and communicate effectively [8], [9]. Software designers have to consider users' emotions and communicate with them to observe what they need implicitly and based on feedback from users it helps to establish the directions of future software [10]. The image of product is subjective, related with users' experience, and emotional factors [11]. Kansei words in Kansei Engineering are used widely to represent users' perception for the products. Emotional perception using Kansei words provides good efficiency and satisfaction [12].

Many researchers adopted Kansei Engineering in the field of e-Learning system in order to support and enhance learning performance. Kansei Engineering is targeted to observe what students completely desire about e-Learning based on their learning experiences and tries to translate it into element designs of e-Learning system. Most of evaluations in Kansei Engineering use multivariate statistical method such as principal component analysis and factor analysis [13]-[16]. Multivariate method explores psychological aspects

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presented by Kansei Words towards specimens in order to find kind of element designs related to e-Learning system. However, multivariate method has difficulty to find a decision for selecting a specimen of e-Learning system. An education institution needs to take a proper decision by involving students as learning actors, in order to implement an e-Learning system appropriately.

Research [17] applied Kansei Engineering into decision support system, but it still used multivariate analysis to select an object. So, we considered to use Analytic Hierarchy Process (AHP) as method to select an object. AHP generally consider non-emotional factors as attributes such as price, popularity, etc [18].

This research attempted to apply Kansei Engineering into a decision support method of AHP in order to provide an education institution such as university to consider students' emotional factors based on their learning experiences. The combination of AHP and Kansei Engineering could provide the best decision about what kind of e-Learning system must be implemented in supporting students' activities. Considering students emotional factors as the fundamental factors on decision of e-Learning system, so the recommended e-Learning system would be used for long time.

## II. KANSEI ENGINEERING AND AHP

This research introduced AHP instead of statistical multivariate in evaluating and analyzing the collected data questionnaire. Fig. 1 shows the systematical processes of evaluation in this research to process data questionnaire step by step from raw data questionnaire to final decision.

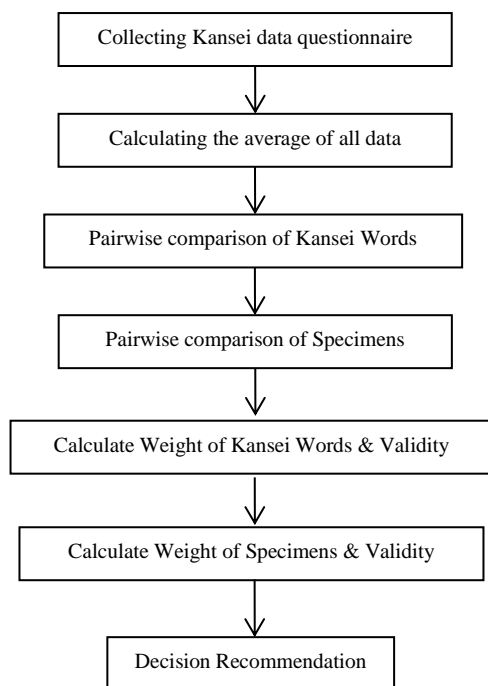


Fig. 1. AHP & Kansei Engineering.

Five open source e-Learning systems such as Moodle, ATutor, ILIAS, Dokeos, and Opigno are prepared as samples or Kansei specimens based on their popularity in around academic institutions' environment. Eight Kansei Words are

selected to represent students' emotional factors toward to e-Learning systems. This research constructed an instrument that consists of each Kansei Words with five points Semantic Differential Scale to measure students' feelings after they look and explore each specimen for a while. 100 university students participated for collecting data questionnaire.

The evaluation begins by calculating the average data of each Kansei Words. After that we have to prepare pairwise comparison of Kansei Words and pairwise comparison of specimens based on each Kansei Words to create matrix comparison. Using matrix comparison of Kansei Words we calculated the weight of each Kansei Words, and also calculate the weight of each specimens based on each Kansei Words. Finally, we combine the weight calculation of Kansei Words and specimens in order to find the most desired an e-Learning system to be recommended. In AHP it is important to check the validity of Kansei Words and specimens to make sure that data consistency and the results are reliable.

## III. RESULT AND DISCUSSION

### A. Data Questionnaire

The first step is to collect adjective words that have closed relationship to e-Learning system by discussing with educational experts and also from related literatures. This research considered eight adjective words as candidate Kansei Words. These words were enough to express the students' emotional feelings toward e-Learning system.

TABLE I: AVERAGE OF RESPONDENTS' DATASET

Kansei Words (KW)	E-Learning System				
	Moodle	ATutor	ILIAS	Dokeos	Opigno
1. Dynamic	3.75	3.67	3.77	2.28	2.36
2. Pleasant	4.02	3.94	2.96	2.86	4.18
3. Simple	3.47	2.31	2.25	3.75	3.62
4. Clear	3.76	3.68	3.92	3.86	3.79
5. Harmony	3.81	3.73	3.80	2.11	2.24
6. Unique	2.36	3.82	3.70	2.17	2.25
7. Formal	2.45	3.68	2.23	3.72	2.16
8. Excellent	2.80	2.87	3.16	2.23	2.20

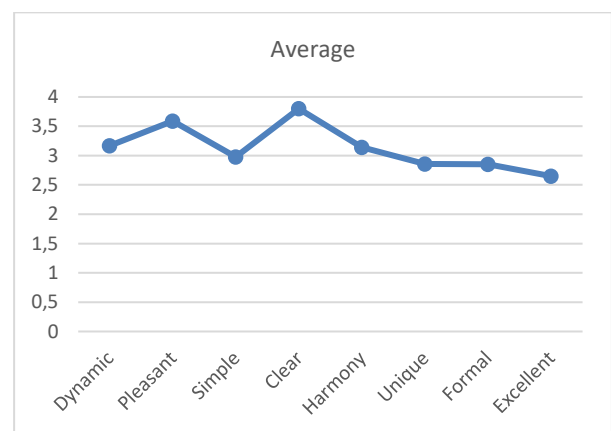


Fig. 2. Average of Kansei Words.

After collecting all data questionnaire from 30 respondents of post graduate students who have enough experience of e-Learning, then we calculated them to find the average values of each Kansei Words as shown in Table I. In Kansei research

commonly used five points semantic differential scale, so each Kansei Words have average's value between 2 and 4 as shown by the graph in Fig. 2.

For further analysis using AHP, it was important to calculate the average of Kansei Words from all specimens as shown at column average in Table I. This average's values were used to calculate pairwise comparison between Kansei Words. The average of Kansei Words at each column of specimens are used to calculate the pairwise comparison between specimens per each Kansei Words. These two types of pairwise comparison are fundamental components to calculate and find the final decision in AHP as described in Fig. 3.

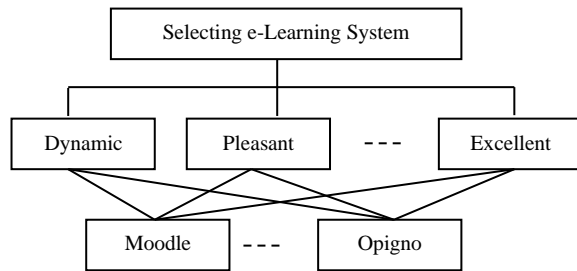


Fig. 3. Kansei Words based AHP.

### B. Kansei Words' Weight Calculation

The pair comparisons between Kansei Words are conducted using data at column average in Table I. These pair comparisons are conducted by substitution operator between two Kansei Words. For example, the calculation between dynamic and informative is  $3.29-3.85=-0.56$ , calculation between dynamic and beautiful is  $3.29-2.65=0.64$ . All these operation's results are shown in Table II.

Data in Table II are then rounded for the next calculation. Because calculation in AHP uses value with starting from 1. Then after rounding process the value has to be incremented by 1 as shown in Table III.

If the result of pairwise comparison is negative then it has to be changed to division, for example the value of pair comparison between dynamic and informative is -2, then it will be changed to  $\frac{1}{2}$ . With the same way, so all these results are shown in Table IV.

TABLE II: KANSEI WORDS PAIRWISE COMPARISON STEP 1

KW	1	2	3	4	5	6	7	8
1	0	-0.42	0.19	-0.63	0.03	0.31	0.32	0.52
2		0.00	0.61	-0.21	0.45	0.73	0.74	0.94
3			0.00	-0.82	-0.16	0.12	0.13	0.33
4				0.00	0.66	0.94	0.95	1.15
5					0.00	0.28	0.29	0.49
6						0.00	0.01	0.21
7							0.00	0.20
8								0.00

TABLE III: KANSEI WORDS PAIRWISE COMPARISON STEP 2

KW	1	2	3	4	5	6	7	8
1	1	-1	1	-2	1	1	1	2
2		1	2	-1	1	2	2	2
3			1	-2	-1	1	1	1
4				1	2	2	2	2
5					1	1	1	1
6						1	1	1
7							1	1
8								1

TABLE IV: KANSEI WORDS PAIRWISE COMPARISON STEP 3

KW	1	2	3	4	5	6	7	8
1	1	1	1	1/2	1	1	1	2
2		1	2	1	2	2	2	2
3			1	1/2	1	1	1	1
4				1	2	2	2	2
5					1	1	1	1
6						1	1	1
7							1	1
8								1

### C. Specimens Weight Calculation

The next preparation has to be done is to calculate the pairwise comparison between two specimens based on each Kansei Words. For example, Table V shows the pairwise comparison due to Kansei Word Dynamic using data in Table I, and the completed pairwise comparison are shown in Table VI and Table VII.

TABLE V: SPECIMENS PAIRWISE COMPARISON STEP 1

Dynamic	Moo-dle	ATutor	ILIAS	Dokeos	Opigno
Moodle	0.00	0.08	-0.02	1.67	1.39
ATutor		0.00	-0.10	1.39	1.31
ILIAS			0.00	1.49	1.41
Dokeos				0.00	-0.08
Opigno					0.00

TABLE VI: SPECIMENS PAIRWISE COMPARISON STEP 2

Dynamic	Moodle	ATutor	ILIAS	Dokeos	Opigno
Moodle	1	1	-1	3	2
ATutor		1	-1	2	2
ILIAS			1	2	2
Dokeos				1	-1
Opigno					1

TABLE VII: SPECIMENS PAIRWISE COMPARISON STEP 3

Dynamic	Moodle	ATutor	ILIAS	Dokeos	Opigno
Moodle	1	1	1	3	2
ATutor		1	1	2	2
ILIAS			1	2	2
Dokeos				1	1
Opigno					1

We also have to calculate the pairwise comparison between specimens based on remaining Kansei Words, and all these results can be found in Table VIII until Table XIV.

TABLE VIII: SPECIMENS PAIRWISE COMPARISON STEP 1

Pleasant	Moodle	A-Tutor	ILIAS	Dokeos	Opigno
Moodle	1	1	3	3	1
ATutor		1	2	2	1
ILIAS			1	1	1/2
Dokeos				1	1/2
Opigno					1

TABLE IX: SPECIMENS PAIRWISE COMPARISON STEP 1

Simple	Moodle	A-Tutor	ILIAS	Dokeos	Opigno
Moodle	1	2	2	1	1
ATutor		1	1	1/2	1/2
ILIAS			1	1/3	1/2
Dokeos				1	1
Opigno					1

TABLE X: SPECIMENS PAIRWISE COMPARISON STEP 1

Clear	Moodle	A-Tutor	ILIAS	Dokeos	Opigno
Moodle	1	1	1	1	1
ATutor		1	1	1	1
ILIAS			1	1	1
Dokeos				1	1
Opigno					1

TABLE XI: SPECIMENS PAIRWISE COMPARISON STEP 1

Harmony	Moodle	A-Tutor	ILIAS	Dokeos	Opigno
Moodle	1	1	1	3	3
ATutor		1	1	3	2
ILIAS			1	3	3
Dokeos				1	1
Opigno					1

TABLE XII: SPECIMENS PAIRWISE COMPARISON STEP 1

Unique	Moodle	A-Tutor	ILIAS	Dokeos	Opigno
Moodle	1	1/2	1/2	1	1
ATutor		1	1	3	3
ILIAS			1	3	2
Dokeos				1	1
Opigno					1

TABLE XIII: SPECIMENS PAIRWISE COMPARISON STEP 1

Formal	Moodle	A-Tutor	ILIAS	Dokeos	Opigno
Moodle	1	1/2	1	1/2	1
ATutor		1	2	1	3
ILIAS			1	1/2	1
Dokeos				1	3
Opigno					1

TABLE XIV: SPECIMENS PAIRWISE COMPARISON STEP 1

Excelent	Moodle	A-Tutor	ILIAS	Dokeos	Opigno
Moodle	1	1	1	2	2
ATutor		1	1	2	2
ILIAS			1	2	2
Dokeos				1	1
Opigno					1

D. AHP Calculation

This research conducts AHP calculation based on data in Table 4 and Table 7 (including remaining Kansei Words comparison based on specimen). It is important in AHP to check data validity by calculating Consistency Index (CI) and Consistency Ratio (CR).

CI, CR, and Alpha calculation of Table 4 has values of 0.0111, 0.0079, and 8.0775 respectively. Table 8 shows the values of CI, CR, and Alpha for all Kansei Words. According to these results, all values of CR are less than 0.1, it means that pairwise comparison between Kansei Words are reliable and can be validated to continue further analysis. Table 15 shows CI, CR, and Alpha of specimens based on each Kansei Words. The results show that all values of CR are less than 0.1, then all data in this research have good validity.

TABLE XV: DATA VALIDITY

Kansei Words	CI	CR	Alpha
Dynamic	0.0049	0.0044	5.0194
Pleasant	0.0064	0.0057	5.0255
Simple	0.0049	0.0044	5.0194
Clear	0.0000	0.0000	5.0000
Harmony	0.0053	0.0048	5.0212
Unique	0.0082	0.0074	5.0329
Formal	0.0069	0.0062	5.0277
Excellent	0.0000	0.0000	5.0000

Final AHP calculations of Kansei Words using online software AHP123 based on data in Table VII – Table XIV and Table IV are illustrated in Fig. 4 and Fig. 5 to show Kansei Words’ impact and to show the rank of each e-Learning system respectively.

The visualization of Kansei Words’s shown in Fig. 4 describes the rank of weight of each Kansei Words. So, we can figure out of the biggest impact of emotional feelings on selection of e-Learning system. According to the result of Fig. 4, we found the two biggest emotional feelings (presented by “pleasant” and “clear”). These two Kansei Words have big impacts on selecting e-Learning system. However, the students’ emotional feeling of “clear” has the biggest impact to prefer a learning system.

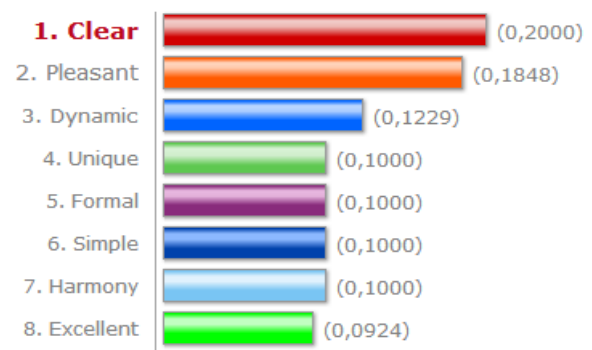


Fig. 4. Kansei Words’ Rank.

Fig. 5 shows the visualization of final result of AHP. It shows which e-Learning system to be considered to implement it based on students’ emotional feelings.

According the result shown in Fig. 5 the most recommended e-Learning system to be implemented were ATutor and Moodle. However, the students slightly preferred to use ATutor than Moodle in order to support their learning activities via internet. Moodle could be considered as alternative e-Learning system because the difference value between both systems was only 0.0094.

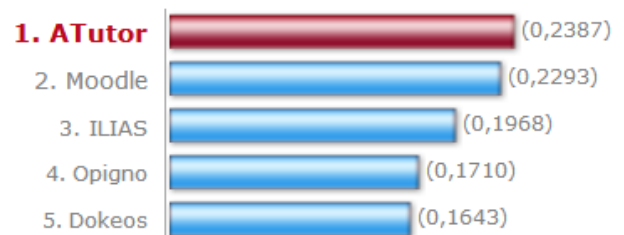


Fig. 5. Specimens’ Ranking

According to these results we found that in order to enhance students’ learning activities using online learning, it was important to consider the interface of e-Learning system based on perspective of students’ emotional feelings, because the interface plays an critical role as bridge between users and internal system. In this case Kansei Words presented by “clear” and “pleasant” have significant impact to appearance of e-Learning system’s interface. In this research, another emotion that also should be considered alternatively in designing interface of e-Learning system in the future is

“dynamic”.

Through this research we also recommends e-Learning developers to pay more attention to explore students' implicit requirements such as emotional feelings, because this factor is the same important as functional factor, in order to develop desired product of e-Learning system.

#### IV. CONCLUSIONS

This research attempts to incorporate Kansei Engineering into AHP in order to find the most suitable e-Learning system based on students' emotional factors. Kansei Words related to open source e-Learning system were used to describe students' emotions. Eight adjective words were used as Kansei Words, and five open source e-Learning system were used as specimens. Kansei Words were involved as attributes of AHP in considering a final decision. Kansei Word of clear has the biggest impact on selecting e-Learning system. ATutor e-Learning system is a recommended kind to be implemented as a learning tool at the institution.

Further research could also highlight the importance to assess e-Learning systems and Kansei at larger scale to generalize findings. Furthermore, comparison of AHP with other decision method could also be of importance, as the findings would be useful to find insights whether more decision method could be combined to find clearer decisions.

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