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Emotional Evaluation about Physico-chemistry Laboratory Equipment's Exterior Design

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Abstract

Laboratory equipment will continue to be developed and created as long as experiments continue. Up until now, the designs have been focused on the functional role; successfully process the study purpose. However, nowadays, the requirements of providing emotional satisfaction of the design, has increased. Even so, the users are normally limited by specific groups and investments on these designs have been neglected due to small annual production by the small market. Through this study, we have conducted an emotional evaluation on Temperature and Humidity Chamber's (TH Chamber) exterior shape. First of all, we extracted emotional words and placed them in categories that represent these emotions and conducted an emotional evaluation on four typical TH chamber models. They were selected based on its door lock type and control box type. The result showed that the 'fixed type' of control box and the 'handle type' of door lock were most favorable by the users, satisfying the five representative emotions; 'Attractiveness', 'Classiness', 'Comfortableness', 'Pleasant' and 'Satisfaction in Usability'. Particularly, all 4 emotional words in the 'Satisfaction in Usability' category recorded over 3.65. This indicates that Satisfaction in Usability is relatively an important category when expressing laboratory equipment. The result of this research is expected to be used as a basic data to find a way of right approach in laboratory equipment design.

Keywords : emotional evaluation, laboratory equipment, temperature and humidity chamber, emotional word, representative emotion

1. Introduction

From the beginning of mankind, mysteries of nature and its phenomenon have been researched an investigated, physically and chemically using various types of laboratory equipment. Beginning with lab equipment made from natural substances such as the 16th century clay and earthenware to high tech equipment of today, these numerous numbers of lab equipment is an essential necessity in obtaining scientific results and data and with the development of all humankind of industry, the types and range of lab equipment expends (Kim, 2006). Laboratory equipment will continue to be developed and be created with ongoing research concerning the phenomenon of nature (Process Worldwide Magazine, 2010). Until now, equipment were only considered for its functional role; successfully carrying out the experimental purpose. However, nowadays, emotional satisfaction from the design is

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increasing in demand. Unfortunately, examples of design orientated equipment are scarce and are mostly found in international products and are hard to find in domestic items. This is because the users are normally limited by specific groups and the design investments have been neglected due to small annual production by the small market. Therefore, study on design to improve the user's workability and comfort is necessary.

Through this study, we conducted emotional evaluation on the thermo-hygrostat's exterior shape. At first, we studied about these equipment's general information and after that, we extracted emotional words and representative emotions and conducted emotional evaluation on four thermo-hygrostat's representative models. With this finding, we are going to find a right way to design laboratory equipment.

2. General Consideration about Physico-Chemistry Laboratory Equipment

2-1. The Concept of Physico-chemistry Laboratory Equipment

In a broad sense, Physico-chemistry Laboratory Equipment or Physical and Chemical Appliances is a measuring tool used for education, research and examination of Physics, Chemistry and Biology (NAVER Encyclopedia). We could consider that laboratory equipment is a tool for studying about physical and chemical phenomenon and they have been used in researches across all the industrial areas. study have been doing all over the industries field. With development of science, mankind has attempted to understand variety of phenomenon through experiments. We could define that the tool, using in all process of experiment to support scientific proves, is the 'Laboratory equipment'.

2-2. The Concept of Temperature and Humidity Chamber

The meaning of the 'Constant Temperature' is a regular temperature and the meaning of the 'Constant Humidity' is a regular humidity (NAVER Korean Language Dictionary). The definition of the 'Constant Temperature and Humidity' is, maintaining regular temperature and humidity (Korean Intellectual Property Office). Thermo-hygrostat or Temperature and Humidity Appliance is an equipment to maintain temperature and humidity. The usage of these equipments is to create a thermal environment in order to perform an experiment assist manufacturing process and control temperature and humidity when storing sensitive goods (Kim, 2005). Furthermore, it is used to protect data processing equipment and communications equipment, which need to be placed in a regular room or a space that can maintain temperature and humidity. Also, to prevent malfunction, variety functions like cooling, heating, reheating, dehumidification, air-cleaning and circulation of gas and air is incorporated. Thus, it is used in super computer rooms, clean rooms, laboratories, garages, environmental test chambers and so on (http://4st.daara.co.kr/231). In conclusion, we could define that the Temperature and Humidity Chamber (TH Chamber) is a manufactured equipment used to study in a fixed temperature and humidity environment for a certain period of time.

On examination of the condition of a temperature and humidity room, supposing that it is a laboratory equipment, the temperature range should be −80℃~+80℃ and its allowable error ±0.05℃~±3℃. The humidity should be 10%~90% and its permissible error ±3%~±10% (Kang & Kim, 1995). On top of these conditions, it needs to be re-created in all - weather situations like rain fall, snow fall and sun's radiation etc. Clean room is required in manufacturing semiconductors and all sorts of bio laboratories because the access of vibration, sound and light need to be limited. During it's operation, the applications like engines, cars, airplanes, houses and clothes. in chamber are

measured by all - weather situations. The biotic environment regulation room is for animals and plants. Also, there are simple functional chambers to store metals (Korean Intellectual Property Office).

2-3. The Components of Temperature and Humidity Chamber

The components of TH[3] chamber are divided into 3 components. They are interior, exterior and the electromagnetic control part (JEIO TECH Co., Ltd.). Its inside consists of technical parts to drive the machine and detailed parts are as follow : body frame, AFI filter, safety device, humidifier, cooling coil, reheating heater, expanding valve, compressor, micro-process and ventilator motor. The outside of the chamber is made up with control parts and a viewing window, door handle, water tank, electronic control parts and operating display. The electromagnetic control part is composed of full touch screen, operating buttons, including software programs. The electronic visual monitor is an operating control unit, mainly made with LCD or TFT. The digital display device is used for the operation of the equipment management, such as the alarm system and a history checker.

3. Extraction of Representative Emotion for TH Chamber's Emotional Evaluation

3-1. Object Extraction to Emotional Evaluation

The majority of the research laboratories and companies use Environmental Stress Screening chamber, is one of the Temperature & Humidity chamber to study, for testing product's durability and reliability. For that reason, the Environmental Stress Screening chamber was chosen as the object of emotional evaluation in this study. Among the laboratory equipment manufacturer, I Surveyed four foreign manufacturing companies, showing high market share in the world, 'Thermo Fisher Scientific', 'ESPEC', 'MEMMERT', and 'WEISS' and three domestic manufacturing companies, leading domestic market, 'NEURONFIT', 'JEIO TECH' and 'Dae-Han Science'. They are on sale or producing both at home and abroad. After the survey, we collected 24 chamber image cuts to take out overlapping or similar equipment in all surveyed image cut. The 24 image cuts are as follows (Figure 1).

Figure 1. Sample of the Temperature and Humidity Chambers

To extract representative models, three experts, over five years experience as a Laboratory equipment designer, over seven years career as a technical designer, and over four years experience as a device analysis staff, have conducted classification of 24 image cuts. Since the inner structures of the equipment are very much similar, immovable parts have been exempt from classifying image cuts. Instead, these are classified in the light of movable or possible to transform parts by door lock shape and control box shape. The door lock has been divided into 'bar type' and 'handle type' and control box has been divided into 'fixed type' and 'movable type'. With these two standards of classification, we made a matrix table to conduct emotional evaluation. The table is as follows (Table 1).

1) An abbreviation of Temperature and Humidity chamber

Table 1. Criteria for Classification

Classification		Door Lock Type	
		Bar Type	Handle Type
Control Box Type	Movable Type	Equipment A	Equipment C
	Fixed Type	Equipment B	Equipment D

The representative TH Chamber of equipment 'A' is 'movable control box' type and 'bar type' door lock. The representative equipment is shown in Table 2.

Table 2. Representative Model of Equipment A

Representative Model	Movable Control Box + Bar Type Door lock
	

The representative TH Chamber of equipment 'B' is 'fixed control box' type and 'bar type' door lock. The representative equipment is shown in Table 3.

Table 3. Representative Model of Equipment B

Representative Model	Fixed Control Box + Bar Type Door lock
	

The representative TH Chamber of equipment 'C' is 'movable control box' type and 'handle type' door lock. The representative equipments are shown in Table 4.

Table 4. Representative Model of Equipment C

Representative Model	Movable Control Box + Handle Type Door Lock
	

The representative TH Chamber of equipment 'D' is 'fixed control box' type and 'handle type' door lock. Most TH Chamber are produced like this form and the representative equipment is as follows (Table 5).

Table 5. Representative Model of Equipment D

Representative Model	Fixed Control Box + Handle Type Door Lock
	

Four representative models were finally selected (Table 6) from each table above to conduct the emotional evaluation.

Table 6. Representative Model

Classification		Door Lock Type	
		Bar Type	Handle Type
Control Box Type	Movable Type	Equipment A 	Equipment C 
	Fixed Type	Equipment B 	Equipment D 

3-2. Extraction of Evaluation Items

In order to select categories for the emotional evaluation of TH Chamber, an existing research finding of Mr. Kim et al.'s (1993) data was applied. It had a collection of emotional words (adjectives) that are possible to express humans' emotions with regards to a product. An adjective is a describing word used to explain shape, situation and properties, and it represents emotional feeling about a subject (Yang, 1974). Hence, 400,000 adjectives from the Korean dictionary were collected (Kim et al., 1992) and any overlapping meanings were ruled out, reducing down to 1,653 adjectives (Park & Kim, 1991). Additionally, 512 adjectives which well-represents human's feeling, were selected and used in a survey to find the suitable words for understanding emotions. In order to do so, they organized abbreviated words using scaling method[4] and re-evaluate it according to the level of emotional feeling. During the evaluation, they picked 256 adjectives with up to grade point average (Kwon et al., 1993). Finally, overlapping meaning of adjectives, ambiguous adjectives and words connected with value were rejected. Through several extracting processes, 40 suitable adjectives were obtained Factor Analysis[5] was conducted using scale method. As a result of the Factor Analysis, 7 standard emotional categories were extracted (Figure 2). They are as such: 'Attractiveness', 'Classiness', 'Comfortableness', 'Openness', 'Pleasant', 'Closeness' and 'Satisfaction in Usability' (Kim et al., 1993).

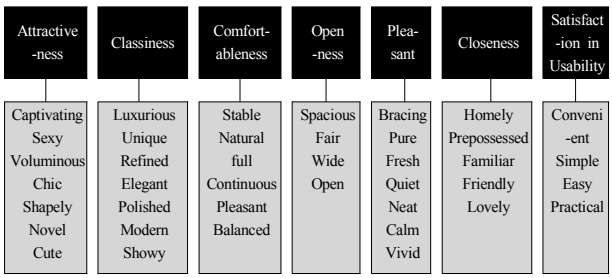

Figure 2. Emotion Category

In this study, selected emotional words from Kim et al.'s (1993) existing findings were evaluated for its appropriateness to further confirm whether the words were suitable or not. The survey was conducted with 42 participants (average age of 35.0, 28 men and 14 women) who are researchers of laboratory equipment's company or users. The evaluation was carried out from Dec., 26th, 2011 to Jan., 3rd, 2012. And it was performed to verify that the 40 emotional words are suitable for emotional evaluation with laboratory equipment using a 5 points Likert scale. As a result, the average value for each emotional words was 2.83 (Std. Deviation 0.92) and 19 words out of 40 words scored above average. But in this survey, the goal was to confirm whether these words are related with

4) Scaling methods is a way to make composite indicator to intensify objectivity of measurement means (Park, 1985).

5) Factor analysis is one of the multi-variate analysis of variance. The variables are explained by common underlying dimensions, made up the basement of variables as analyzing correlation of variables. The basic concept of factor analysis is redefining fewer factors, extracted from variety of variables. During this analysis, the variables have to preserve its own properties to minimize information loss (Lee & Kim, 2001).

emotional description of laboratory equipment. Thus, we extracted words which scored above 3, in the 5 points Likert scale (Table 7). These words then were distributed evenly into the seven categories. However, there were no words suitable for the category of 'Openness' and only the word 'familiar',scored 3.03. was suited for the category 'Closeness'. Hence these two categories were taken out from the study. Also, it is interesting to note that all four words in the category of Satisfaction in Usability scored above 3.65 out of 5. This indicates that 'Satisfaction in Usability' is relatively an important category in expressing laboratory equipment. Once the finalized 14 emotional words were placed into 5 categories; 'Attractiveness'. 'Classiness', 'Comfortableness', 'Pleasant' and 'Satisfaction in Usability', it was used to evaluate the emotion sensed from the TH Chambers (Figure 3).

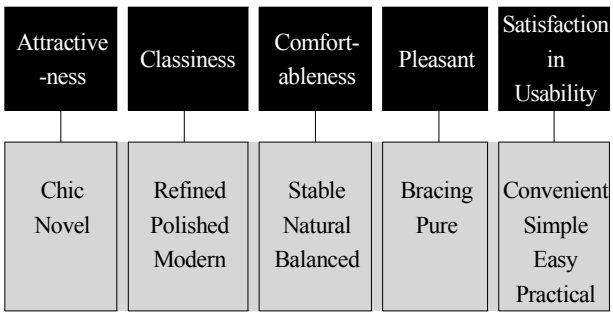

Figure 3. Representative Emotion for Laboratory Equipment

Table 7. Result of the Appropriateness Evaluation of Emotional Words

Representative Emotion	Emotional Word	Mean	Std. Deviation	Analysis N.
Attractiveness	01. Captivating	2.83	0.98	40
	02. Sexy	2.15	0.77	40
	03. Voluminous	2.53	0.93	40
	04. Chic	3.50	0.78	40
	05. Shapely	2.93	0.92	40
	06. Novel	3.55	0.71	40
	07. Cute	2.40	1.01	40
Classiness	08. Luxurious	2.35	1.10	40
	09. Unique	2.98	1.03	40
	10. Refined	3.40	0.71	40
	11. Elegant	2.88	1.07	40
	12. Polished	3.88	1.16	40
	13. Modern	4.00	0.96	40
	14. Showy	2.38	0.95	40
Comfortableness	15. Stable	3.78	0.86	40
	16. Natural	3.08	0.83	40
	17. full	2.55	1.09	40
	18. Continuous	1.88	0.82	40
	19. Pleasant	2.00	0.91	40
	20. Balanced	3.58	0.87	40
Openness	21. Spacious	2.58	0.87	40
	22. Fair	2.35	1.12	40
	23. Wide	2.10	1.01	40
	24. Open	2.38	0.84	40
Pleasant	25. Bracing	1.93	0.89	40
	26. Pure	3.45	0.85	40
	27. Fresh	2.95	1.26	40
	28. Quiet	2.05	1.06	40
	29. Neat	3.20	0.82	40
	30. Calm	1.65	0.66	40
	31. Vivid	2.45	0.93	40
Closeness	32. Homely	1.60	1.03	40
	33. repossessed	2.88	0.82	40
	34. Familiar	3.03	0.70	40
	35. Friendly	1.88	0.72	40
	36. Lovely	2.58	0.98	40
Satisfaction in Usability	37. Convenient	4.03	0.83	40
	38. Simple	3.80	1.14	40
	39. Easy	3.65	0.89	40
	40. Practical	4.20	0.85	40

4. Emotional Evaluation of Temperature and Humidity Chamber

4.1. Experiment Overview

The main goal of this experiment is to emotionally evaluate the exterior of Temperature and Humidity Chamber. Emotional evaluation upon observation of the 4 representative models of TH chamber with 14 emotional words was conducted with a 5 point scale (1. Not very likely, 2. Not likely, 3. Likely, 4. Much likely, 5. Very much likely) to test the emotional degree by the users. The 40 survey participants were composed of 20 hand on workers (average age of 35.2, 14 men and 6 women) who work in the TH Chamber's development company and 20 graduate students (average age of 25.2, 12 men and 8 women) who have an experience in using a TH chamber (Table 8).

Table 8. Participant

Classification	N. of Participant	Male / Female	Average Age (Std. Deviation)
Hands-on Worker	20	14	35.2 years old (5.11)
		6	
Graduate Students	20	12	25.2 years old (2.46)
		8	
Total	40	26	30.2 years old (1.87)
		14	

We arranged emotional evaluation value with 5 extracted representative emotions Attractiveness, Classiness, Comfortableness, Pleasant, Satisfaction in Usability based on 5 Likert scale score, measured by 14 emotional words. As using SPSS 13.0 for Windows statistic program whereby based evaluation value for representative emotion, We studied the Existence of meaning about the average value differences of 5 representative emotion for each representative equipment models and compared the average value of emotional evaluation about each representative equipment models.

4.2. Experiment Results

One-way analysis of variance (one-way ANOVA) was used in this study to see if the difference of the average values of more than two groups is significant by using SPSS 13.0 for Windows statistic program. We set up hypothesis as following to verify the difference of the average values of more than two groups through one-way ANOVA.[6)]

- Null Hypothesis (H0): There is no difference in the average of more than two groups.(*H0*: $\mu_1 = \cdots\cdots = \mu_i$)
- Alternative Hypothesis (H1): Not all averages of more than two groups are equal (In other words, there is a difference between at bett two group.(*H1*: $\mu_i \neq \mu_j$, at least on one of *i and j which are different*)

Also, further verification was performed to confirm that the difference in the average of two groups was valid. In this research, further multiple comparisons were performed on the basis of the one-way ANOVA result carried out above. The methods for further multiple comparisons are Tukey method, Scheffé method, and, Bonferroni method etc. The Tukey method is used when the sizes of each cell (the case numbers of each group) are same, and the Scheffé method and Bonferroni method are used when the sizes of each cell do not matter. When the sizes of each cell are same, the Tukey method can precisely detect the difference among the groups (Lee & Kim, 2001). In this study, the Tukey method was used to perform further multiple comparisons because the sizes of each cell were same. At the same time, we conducted

6) ANOVA(analysis of variance) is a statistic program to see if the difference of the average values of more than 2groups. Then verification is F. The simplest ANOVA is one-way ANOVA (Lee & Kim, 2001).

Duncan test for grouping words based on further verification results. Duncan Test uses a verifying method that calculates the group average of rank and range value.

4.2.1. Emotional Evaluation Results for each Temperature and Humidity Chamber

The result of emotional evaluation for each TH Chamber is shown in Table 9 and Figure 4.

Table 9. Result of Emotional Evaluation for each Equipment

Equip-ment	Representative Emotion	Mean	Std. Deviation	N. of Participant
Equipment A	Attractiveness	3.58	0.80	40
	Classiness	3.55	0.77	
	Comfortableness	3.24	0.66	
	Pleasant	3.59	0.78	
	Satisfaction in usability	3.32	0.87	
Equipment B	Attractiveness	2.53	0.88	40
	Classiness	2.66	0.92	
	Comfortableness	3.23	0.88	
	Pleasant	3.16	1.05	
	Satisfaction in usability	3.16	0.78	
Equipment C	Attractiveness	2.73	0.76	40
	Classiness	2.91	0.74	
	Comfortableness	3.55	0.70	
	Pleasant	3.64	0.92	
	Satisfaction in usability	3.50	0.74	
Equipment D	Attractiveness	3.66	0.76	40
	Classiness	3.83	0.66	
	Comfortableness	3.99	0.57	
	Pleasant	3.88	0.67	
	Satisfaction in usability	3.62	0.61	

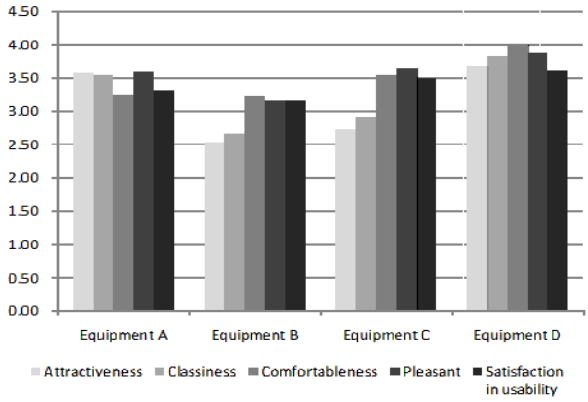

Figure 4. Result of Emotional Evaluation for each Equipment

For Equipment A (movable control box type+bar type door lock), 'Pleasant' (3.59/5.00) scored the highest but the difference among the 5 representative emotions was only slight. All five categories recorded an average of 3 points. The test result of Equipment B (fixed control box type+bar type door lock) and Equipment C (movable control box type+handle type door lock) had a similar aspect. 'Comfortableness', 'Pleasant' and 'Satisfaction in Usability' were recorded average 3 points whereas, 'Attractiveness' and 'Classiness' were relatively lower than others with a score of 2 points. In the result of Equipment D (movable control box type+bar type door lock), the average value of 5 representative emotion was higher throughout the emotional words in 4 representative equipment than other equipment. Among the five categories, 'Comfortableness' (3.99/5.00) was recorded the highest in the area but the differences among the categories were mere with an average of 3.6 or higher.

4.2.2. The Difference Validation of Representative Emotion's Average Value for each Temperature and Humidity Chamber

At first, as the result of one-way ANOVA verification that was performed to verify that the difference for 5 representative emotions' average value differences were valid about equipment A, the

null hypothesis did not rejected with a p-value of 0.143 and significance level of 0.05 (Table 10). It means that 5 representative emotions' average value differences of equipment A is not difference.

Table 10. Variance Analysis Result of Emotional Evaluation for Equipment A

Classification	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.202	4	1.051	1.740	0.143
Within Groups	117.712	195	0.604		
Total	121.914	199			

As the result of one-way ANOVA verification about equipment B, the null hypothesis was rejected with a p-value of 0.000 and significance level of 0.05 (Table 11). Thus, 5 representative emotions' average value differences of equipment B is difference. At least, in between the two representative emotions' average value have difference averages.

Table 11. Variance Analysis Result of Emotional Evaluation for Equipment B

Classification	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	17.345	4	4.336	5.276	0.000
Within Groups	160.269	195	0.822		
Total	177.614	199			

As the result of further multiple comparison, using Tukey method, the difference of Attractiveness and Comfortableness (p=0.005), Pleasant (p=0.016), Satisfaction in Usability (p=0.018) and Classiness and Comfortableness (p=0.040) were valid at a significance level of 0.05. Other cases did not have valid differences. From the Duncan test, Attractiveness and Classiness were grouped on one and Satisfaction in Usability, Pleasant, Comfortableness were grouped in one (Table 12). In other words, Attractiveness and Classiness were relatively low scored than other 3 representative emotions.

Table 12. Result of Duncan Test for Equipment B

Representative Emotion	Subset for alpha = .05		N. of Participant
	1	2	
Attractiveness	2.53		40
Classiness	2.66		
Satisfaction in usability		3.16	
Pleasant		3.16	
Comfortableness		3.23	
Sig.	0.511	0.723	

As the result of one-way ANOVA verification about equipment C, the null hypothesis was rejected with a p-value of 0.000 and significance level of 0.05 as like equipment B (Table 13). Thus, 5 representative emotions' average value differences were difference. There was a difference in the average in between at least two representative emotions.

Table 13. Variance Analysis Result of Emotional Evaluation for Equipment C

Classification	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27.761	4	6.940	11.551	0.000
Within Groups	117.158	195	0.601		
Total	144.918	199			

As the result of further multiple comparison, using Tukey method, the difference of Attractiveness and Comfortableness (p=0.000), Pleasant (p=0.000), Satisfaction in Usability (p=0.000) and Classiness and Comfortableness (p=0.003), Pleasant (p=0.000), Satisfaction in Usability (p=0.007) were valid at a

significance level of 0.05. Other cases did not have valid differences. Through the Duncan test, Attractiveness and Classiness were grouped in one and satisfaction in usability, Pleasant, Comfortableness were grouped in one (Table 14). To conclude, Attractiveness and Classiness were relatively a little lower than other 3 representative emotions as like equipment B.

Table 14. Result of Duncan Test for Equipment C

Representative Emotion	Subset for alpha = .05		N. of Participant
	1	2	
Attractiveness	2.73		40
Classiness	2.91		
Satisfaction in usability		3.50	
Comfortableness		3.55	
Pleasant		3.64	
Sig.	0.291	0.459	

And finally, As the result of one-way ANOVA verification, the null hypothesis did not rejected with a p-value of 0.070 and significance level of 0.05. As like equipment A, 5 representative emotions' average value differences of equipment D was not difference (Table 15).

Table 15. Variance Analysis Result of Emotional Evaluation for Equipment D

Classification	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.806	4	0.952	2.200	0.070
Within Groups	84.356	195	0.433		
Total	88.162	199			

4.2.3. Average Difference Validation of TH Chamber's Emotional Evaluation for each Representative Emotions.

The emotional evaluation results of TH chambers (equipment A, B, C and D) for each representative emotion are like Figure 5. As for the average value of Equipment A and D was a little was higher than equipment B and C. Equipment D was highest in Comfortableness, and equipment B showed the lowest in Pleasant compare to other 3 equipments. With the Satisfaction in Usability, Emotional evaluation value of all equipments showed the same but equipment B was different. It represented relatively little lower than others.

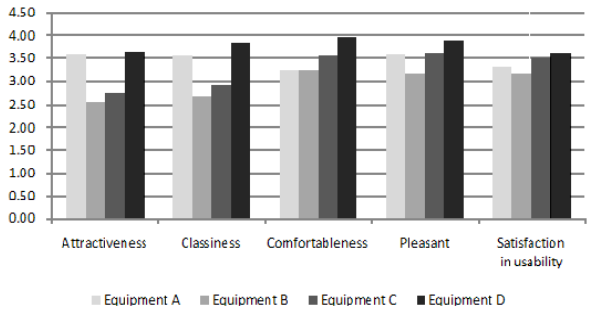

Figure 5. Result of Emotional Evaluation for each Representative Emotion

The verifying result of one-way ANOVA verification that was performed to verify that the difference of TH chamber of emotional evaluation's average value differences for each representative emotions is like Table 16. There through, the null hypothesis were rejected in Attractiveness ($p=0.000$), Classiness ($p=0.000$), Comfortableness ($p=0.000$), Pleasant ($p=0.004$), Satisfaction in Usability ($p=0.037$). It means that Th chamber's value did not identical. There is a difference in the average in between at least two TH chambers.

Table 16. Variance Analysis Result of the Average of each Representative Emotion among Four Equipments

Representative Emotion	Classification	Sum of Squares	df	Mean Square	F	Sig.
Attractiveness	Between Groups	40.455	3	13.485	20.949	0.000
	Within Groups	100.419	156	0.644		
	Total	140.873	159			
Classiness	Between Groups	35.858	3	11.953	19.742	0.000
	Within Groups	94.450	156	0.605		
	Total	130.308	159			
Comfortableness	Between Groups	15.281	3	5.094	10.038	0.000
	Within Groups	79.161	156	0.507		
	Total	94.442	159			
Pleasant	Between Groups	10.555	3	3.518	4.711	0.004
	Within Groups	116.506	156	0.747		
	Total	127.061	159			
Satisfaction in Usability	Between Groups	4.954	3	1.651	2.896	0.037
	Within Groups	88.958	156	0.570		
	Total	93.912	159			

Through the Tukey method and duncan test, posteriori tests were performed to verify that average value differences among equipments were valid. As the result of further multiple comparison, using Tukey method, within Attractiveness, the difference of equipment A and equipment B (p=0.000), C (p=0.000) and the difference of equipment D and equipment B (p=0.000), C (p=0.000) were valid at a significance level of 0.05. Other cases did not have valid differences. Through the Duncan test, Equipment B, C were grouped in one and equipment A, D were grouped in one (Table 17). As the final outcome, in case of Attractiveness, we can say that Equipment A, D were relatively higher than equipment B, C.

Table 17. Result of Duncan Test for Attractiveness

Equipment	Subset for alpha = .05		N. of Participant
	1	2	
Equipment B	2.53		40
Equipment C	2.73		
Equipment A		3.58	
Equipment D		3.66	
Sig.	0.267	0.626	

Also, as the result of further multiple comparison, using Tukey method, within Classiness, the result showed same patterns as in Attractiveness. The difference of Equipment A and equipment B (p=0.000), C (p=0.002) and the difference of equipment D and equipment B (p=0.000), C (p=0.000) were valid at a significance level of 0.05. Other cases did not have valid differences. Through the Duncan test, equipment B, C were grouped in one and equipment A, D were grouped in one too (Table 18). Like the result of Attractiveness, Equipment A, D were relatively higher than equipment B, C.

Table 18. Result of Duncan Test for Classiness

Equipment	Subset for alpha = .05		N. of Participant
	1	2	
Equipment B	2.66		40
Equipment C	2.91		
Equipment A		3.55	
Equipment D		3.83	
Sig.	0.153	0.105	

In the test of Comfortableness, The difference of Equipment D and Equipment A (p=0.000), C (p=

0.031) were valid at a significance level of 0.05. Other cases did not have valid differences. As the result of duncan test, equipment B, A and C were grouped in one and equipment D was grouped in one (Table 19). In conclusion, equipment D was relatively higher than equipment A, B, C in this test.

Table 19. Result of Duncan Test for Comfortableness

Equipment	Subset for alpha = .05		N. of Participant
	1	2	
Equipment B	3.23		40
Equipment A	3.24		
Equipment C	3.55		
Equipment D		3.99	
Sig.	0.061	1.000	

In case of the Pleasant, only the difference of Equipment D and Equipment B (p=0.002) were valid at a significance level of 0.05. Other cases did not have valid differences. But as the result of duncan test, equipment B was grouped in one and equipment A, C, D became a group (Table 20). In conclusion, equipment B was relatively lower than equipment A, C, D in this validation.

Table 20. Result of Duncan Test for Pleasant

Equipment	Subset for alpha = .05		N. of Participant
	1	2	
Equipment B	3.16		40
Equipment A		3.59	
Equipment C		3.64	
Equipment D		3.88	
Sig.	1.000	0.163	

Finally, as the result of further multiple comparison, using Tukey method, within Satisfaction in Usability, the result showed same pattern as in Pleasant. only the difference of Equipment D and equipment B (p=0.000), were valid at a significance level of 0.05. Other cases did not have valid differences. duncan test, the differences of result showed compare with the result of Pleasant. Equipment A, B and C were grouped in one and equipment A, C, D were grouped in one too (Table 21). It means that equipment B was lower than equipment D and equipment was higher than equipment B.

Table 21. Result of Duncan Test for Satisfaction in Usability

Equipment	Subset for alpha = .05		N. of Participant
	1	2	
Equipment B	3.16		40
Equipment A	3.32	3.32	
Equipment C	3.50	3.50	
Equipment D		3.62	
Sig.	0.055	0.095	

5. Discussion and Conclusion

Through this study, emotional evaluation on Temperature and Humidity Chamber's exterior shape was conducted. First of all, 14 emotional words were extracted and 5 representative emotions; 'Attractiveness', 'Classiness', 'Comfortableness', 'Pleasant', 'Satisfaction in Usability', were selected to conduct an emotional evaluation about the Temperature and Humidity Chamber's representative models. Depending on the door lock type and control box type, the TH Chambers were divided into four models. From the emotional evaluation, following conclusions were made. For Equipment A (movable control box type+bar type door lock), the difference among the 5 representative emotion was only slight and most were recorded with an average 3 points. This

means that the users didn't think too badly of equipment A's design. The test result of Equipment B (fixed control box type+bar type door lock), the average value was lower than any other 3 equipment. Therefore it can be concluded that this equipment would not be suitable as a satisfactory exterior shape. In the case of Equipment C (movable control box type+handle type door lock), 'Comfortableness', 'Pleasant', 'Satisfaction in Usability' were recorded above 3.5 points whereas 'Attractiveness' and 'Classiness' were relatively lower than others. Hence, this equipment is neither luxurious nor attractive looking like equipment B. In the result of Equipment D (movable control box type+bar type door lock), the average value of 5 representative emotions were highest among the 4 representative equipments. Among the five representative emotions there were no differences in the 5 emotional values. Thus, the 'fixed type' control box and the 'handle type' door lock make an adequate TH Chamber with satisfies the five representative emotions; 'Attractiveness', 'Classiness', 'Comfortableness', 'Pleasant', 'Satisfaction in Usability' by the user. The laboratory equipment's shape of movable type of control box and bar type door lock, protruding to the outside, may seems complex and fixed type of control box and handle type of door lock, unitized with laboratory equipment, may seems simple. Therefore, when we consider characteristics of scientists who are mainly use laboratory equipment (Jeong & Jeong, 2009) and laboratory equipment's characteristics, we could say that user prefer a simple shape of laboratory equipment. Particularly, all 4 emotional words in the 'Satisfaction in Usability' category recorded over 3.65. This indicates that Satisfaction in Usability is relatively an important category when expressing laboratory equipment. The result of this research is expected to assist the way of find approaching laboratory equipment designs. However, there are limitations to this study. The two conditions for choosing the representative models are not an absolute standard. Additionally, the participants may see the overall exterior shape rather than the proposed design condition of the exterior. Therefore, this study's argument – 'fixed type' of control box and 'handle type' of door lock design of a TH Chamber is ideal with regards to satisfying the customer's emotions – may not be rational.

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