



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

**ScienceDirect**

Procedia Manufacturing 3 (2015) 2288 – 2294

**Procedia**  
MANUFACTURING

6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the  
Affiliated Conferences, AHFE 2015

## A study on the forms and user's behaviors of the public seats in National Taipei University of Technology

Tien-Ling Yeh, Chieh-Ju Huang\*

*Doctoral Program in Design, College of Design, National Taipei University of Technology, Taipei, 10608, Taiwan*

---

### Abstract

To the students, school is the main living and activity space in the school semester, however, it was found that students only stay in the classroom to communicate with others using 3C hardware, students rarely go to outdoor space to have exchange with peers or teachers. In this study, starting from student's point of view, appropriateness and form of user's experience are used to investigate the form and user's demand and interactive behavior of outdoor public seat in the campus of National Taipei University of Technology. The implementation way can be divided into three stages: (1) Analyze the present public seats in the campus. (2) Questionnaire is used to investigate the form of the public seats in the campus and user's experience. (3) Through workshop, QFD method is used to investigate important design factors of user's demand and seat function. The main issuance targets of the questionnaires are students teaching staff of National Taipei University of Technology, and it comes to a total of 30 copies. The participating targets of the workshop are mainly five graduate students of the graduate institute of innovative design. Finally, the following research results are achieved: (1) Seat surrounding a tree is the most popular type of seat, people is willing to use it, the next is seat of single-person form. (2) Seat of multi-person form is the most comfort type of seat. It is including table and seats, people able to work comfortably and hands are gotten supporting. (3) User's demand perspective: Currently, important demand factors recognized by users are easy-to-clean, changeable user's scenario and easy-to-move, the next are appearance, shape, color, fun and interactivity, etc. (4) Product's function perspective: Currently, the first priority considering design factors in functionality are lighting function, easy-to-maintain, can-be-assembled and light weight material, the next is charging function and weather resistant material.

© 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of AHFE Conference

*Keywords:* Forms; Public seats; University; User's behaviors

---

\* Corresponding author. Tel.: +886-934154531.  
E-mail address: [tienling0303@gmail.com](mailto:tienling0303@gmail.com)

## 1. Introduction

In Taiwan, 23.34% of the population of 15 years old and over feels that they always or often don't have enough time to be with families or friends. 61.09% occasionally or rarely feels that way. And 15.57% never feels so [1]. People don't have much time with their families and friends, yet, due to the advancement of technology and popularization of smart phones and tablet PCs, it is very common that people still concentrate on their 3C products while dining or getting together with their families or friends. One of the results is to distance from families and friends. Campuses are places to learn knowledge, as well as places for both teachers and students. However, during semesters, students spend 87% of their time engaging in required activities (including going to classes, reading, doing homework, writing reports, borrowing books / looking for information, taking exams, etc.) Only 11% of their time is after-class break time (for chatting or taking a break). And merely 2% is spent working (doing a part-time job or tutoring) [2]. Students only have very less time after-school and during breaks to exchange views with their teachers and peers. Nowadays, students are used to communicate with others through 3C products, leading to the degeneracy of many social abilities. Or, in some cases, the lack of a normal communication channel can lead to various social or family issues. Therefore, it is necessary for campuses to offer a more appropriate outdoor open space for teachers and students.

## 2. Literature

### 2.1. Literature regarding campus seats

#### 2.1.1. Man

The aspects of physiological and psychological comfort: (i) The aspect of physiological comfort: Campus seats should be designed based on ergonomics, and the physiological and psychological factors of human body structure should all be taken into consideration. Thus, the external environments must be analyzed and physical design principles and design skills must be applied, in order to achieve expected effects for users. Hou [3] summarized the physiological factors related to seats into 5 factors: size, material, modeling, location and combination, and microclimate influence. (ii) The aspect of psychological comfort: One of the theories regarding psychological comfort is about crowding. For people, the perception of crowding is related to the order of a group of people in a unit space. When staying in an overcrowding space, a person's psychological comfort aspect may be influenced.

In "The Hidden Dimension", Hall [4] proposed the concept of individual space. The distance between two individuals is a nonlinguistic form of communication between them. People use different space ranges according to conditions of different scenarios. Hall believed that there are 4 types of distance between two individuals when they interact with each other, which are intimate distance, personal distance, social distance, and public distance. These 4 types of distance can be distinguished based on their lengths. Intimate distance: 0-45 cm; personal distance: 45-120 cm; social distance: 1.2-3.5 m; and public distance: 3.5 m and above.

#### 2.1.2. Machine

According to Guan [5], scenarios of sitting on a seat can be categorized into long-time thinking scenarios, short-time break scenarios, and form transformation scenarios. However, scenarios of sitting on a public seat are usually short-time break or form transformation scenarios. Public seats are for short-time sitting. Thus, their main purpose is to share a part of users' body weight, not to satisfy users who need to rest in a sitting, lying, or leaning posture. One example of form transformation seats is the auxiliary seats mentioned by Jan Gehl [6]. These seats are originally objects which have no sitting function in the environment. However, their forms are perfect for users to sit on and rest. Thus, these objects can be transformed into alternatives of seats.

#### 2.1.3. Environment

"A Pattern Language" [7] mentioned that a place to wait in a public space and activity nodes are the important contact points where people stop and stay to communicate and interact. There is also the so-called edge effect. That means those who stop tend to gather by the edge of a plaza, in front of a building, by a doorpost, inside a cave-in

space of a wall, or by a pillar. People always rest along the edge of a space. A space which provides some shelters or something to lean on can make people feel safer.

2.2. Analyses of current products and foreign cases

There are a lot of public seats. 3 very common models of public seats in campuses are summarized below with analyses based on the “man-machine-environment” method in human factor engineering, as shown in Table 1:

Table 1. Several common models of public seats in campuses (Source: summarized by this study).




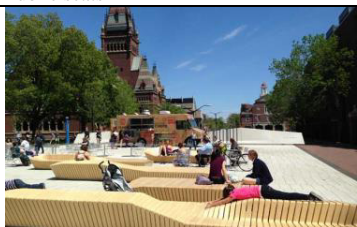


Current Product	Human	Machine	Environment
	Longer length for more users	Made of wood and built along the fence to save public space	Form transformation Outdoor Near flower beds with mosquito problems
	Various directions for users to choose when sitting	Made of wood and stone and built squarely around a tree, possibly resulting in reducing pedestrian space	Outdoor Easy to go with surroundings
	Rather small sitting area for few users	Made of stone, rather firm due to the design and material	Outdoors On roadsides, with the possibility to cause crowding and security issues

Table 2. Public seats in other countries (Source: summarized by this study).

Public seats	Feature
	The Plaza at Harvard, 2013 [8] Diversified designs for users to rest in various postures or to perform different activities, with a lot of ways to seat
	Polymorphic Kinetic Bench, 2011 [9] Dynamic and changing according to users' postures, to increase comfort, pleasure, and interactivity

Public seats	Feature
	Lincoln Seats for 2010 [10] Flexible with various ways to assemble based on requirements of activities, so that users can choose different ways to seat according to their relationship with each other

In sum, after referencing the foreign cases, it is obvious that dynamic products with flexibility in assembly are more likely to keep users staying and performing various activities. These products are not complex in design. They are mostly made of wood which can create a warm feeling. This information can be used as a reference for designers.

### 3. Research methods

#### 3.1. Questionnaire survey

- Questionnaire survey: investigating users' preferences for the forms of public seats in campuses and their experiences
- Subjects: Teachers, administrative personnel, and students from National Taipei University of Technology
- Number of questionnaires issued: 30

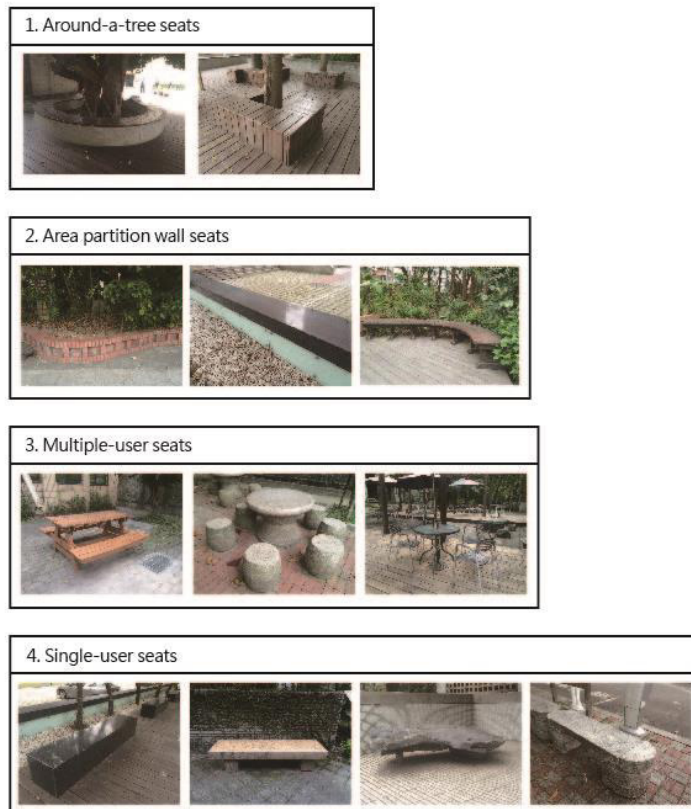


Fig. 1. Four types of public seats.

- Time: 2014/12
- Location & method: 30 questionnaires were issued through the internet.
- Variables
  - Independent variables: 4 types of public seats in campuses, labeled as “seat 1”, “seat 2”, “seat 3”, and “seat 4” as above fig. 1. , respectively for the survey.
  - Dependent variables: 10 questions from the system usability scale (SUS) using the Likert 5-point scale with options including “strongly agree, agree, not sure, disagree, and strongly disagree”
- Statistical analyses
  - Descriptive statistics: basic statistics of the data
  - ANOVA: analyzing the influence of the forms of seats on users’ subjective perception and usage experiences.

3.2. Workshop

- Workshop: Exploring users’ requirements and important factors for designing seats
- Subjects: 5 graduate students from the Graduate School of Innovation & Design
- Time: 2015/01
- Through collective thinking in the workshop, in the process from divergence to convergence, the relationships between the problems of the current products and users’ experiences were discovered. Then quality function deployment (QFD) was applied to clarify the interactive relationships between users’ demands and product features. Then the order of importance was obtained efficiently.

4. Results

4.1. Descriptive statistics

A total of 30 questionnaires were retrieved, among which, 22 were from students and 9 were from others. The ages of the subjects were between 16 and 53 years old. The average age is 29.4 (years old). 12 of the subjects are male and 18 are female.

Table 3. Demographic statistics of the data.

	No.	Min	Max	Avg.	S.D.
Gender	30	1.00	2.00	1.60	.498
Age	30	16.00	53.00	29.40	8.747
Identify	30	1.00	4.00	1.63	1.129

4.2. Results of the ANOVA

The significance results of the test of homogeneity ( $P > 0.05$ ) and ANOVA ( $P < 0.05$ ) regarding the influences of users’ preferences for the forms of public seats in campuses and their experiences are summarized in Table 4 below.

Table 4. The influence of the forms of seats on users’ subjective perception and usage experiences

Independent Variable	Dependent Variable	Sum of Square	Degree of Freedom	Mean Square	F-test	Significance
Seat 1	I am willing to use the public seats in the campus frequently.	7.243	4	1.811	3.622	.019
	I think most people like to use the public seats in the campus.	10.713	4	2.678	4.763	.006
Seat 3	I think the public seats in the campus are very comfortable.	5.912	4	1.478	2.718	.050

### 4.3. Results of workshop

Based on the workshop discussion results (Table 5), QFD was applied to analyse the aspects of users' demands and product functions. The results are summarized in Table 6 and Table 7. These important factors should also be taken into consideration when designing a public seat for a campus.

Table 5. Items of the aspect of required quality.

First-order	Second-order	Third-order
Physiological Aspect	Function	Easiness to maintain, climate resistance, easies to be vandalized, easies to clean, chargeability, endurance, write-protection, and design for assembly
	Appearance	Weight and stability, consistency in overall design, and brightness of seat color
	Cleanness	Drink stains, distance to soil, and mosquitoes
	Security	Illumination
	Human factor	Backrest, arm support, and easiness to sit on
Psychological aspect	Location and distance	Direction of seat, convenience of geographic location, and distance of personal space
	User scenario	Combination with information booth, integration into environment, consideration of work scenario, customization based on users' requirements, integration with features of environment/construction, and interaction

Table 6. Items of the aspect of users' demands, ordered by importance.

Rank	Item	Weight
1	Easiness to clean	16.1
2	Consideration of working scenario	14.5
3	Easiness to move	14.5
4	Interaction	12.9
5	Brightness of color	12.9
6	Sunshade	12.9
7	Cleanness	12.9
8	Combination of information booth	3.2

Table 7. Items of the aspect of product functions, ordered by importance.

Rank	Item	Weight
1	Lighting	17.9
2	Easiness to maintain	16.3
3	Design for assembly	15.3
4	Weight	12.0
5	Chargeability	11.7
6	Moisture-proof	11.5
7	Climate resistance	9.1
8	Consistency in design	6.3

## 5. Conclusions and discussions

This study aimed to apply QFD and SUS to explore the behaviors and demands of public seat users, as well as the relationships with product functions. The results can be used as a reference for the R&D of public seat products for campuses. Furthermore, appropriate product features can be identified to ensure design specifications and goals are correct.

According to the findings of this study, among various current types of public seats for campuses, most people prefer the around-a-tree seats. They are willing to use this type of seats often. The next preferred type is the multiple-user seats. Each of these seats goes with a table. People are more comfortable sitting on this type of seats while working. Their arms can be supported. Also, the results from the QFD analysis show that the items of the aspect of users' demands, ordered by importance, are easiness to clean, changeability of user scenario, easiness to move, appearance, color, interesting interaction. In the aspect of product functions, the elements to be considered first during the design process include lighting, easiness to maintain, design for assembly, and weight, followed by chargeability and climate resistance. In the aspect of users' demands, solutions can be developed with various product functions. Thus this aspect should also be taken into consideration while designing public seat products.

For the future researches, it is recommended that focus can be put on the modularization design, and affordance theory can be extended to be used as direction of verification and improvement for future product.

## References

- [1] The Statistics of Taiwan's social development trends in 2004. (2004). Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. Retrieved from <http://www.stat.gov.tw/lp.asp?CtNode=2296&CtUnit=1818&BaseDSD=29&mp=4>.
- [2] Hsu, Y.C, Chuang, L.J, et al. (2007). Measuring Leisure and Free Time Usage of College Students: A Time Diary Approach, *Tourism Research Journal*; Vol.13, No.4, P289-308
- [3] Hou, J.S. (1985). Investigating the rest facilities of park and visitors' behaviors, *Journal of Tunghai University-Applied Science*, 46.
- [4] Hall, E.T. (1966). *The hidden dimension*. New York: Doubleday.
- [5] Guan Z.N. (1994). *Public Art Series - Public Outdoor Furniture*, Ministry of Culture.
- [6] Gehl Jan, (1996). *Life Between Building*, Chen C.L, Taipei, Garden City publishers.
- [7] Alexander C., Ishikawa S., Silverstein M., (1977). *A Pattern Language*, New York , Oxford University Press
- [8] *The Plaza at Harvard*, (2013) .Retrieved from <http://www.stoss.net/projects/16/the-plaza-at-harvard/>
- [9] *Polymorphic Kinetic Bench*. (2011). Designmilk, Retrieved from <http://design-milk.com/polymorphic-kinetic-bench/>
- [10] *Lincoln Seats for 2010*. (2010). Yanko Design, Retrieved from <http://www.yankodesign.com/2010/01/06/lincoln-chairs-for-2010/>